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Hawai'i IDeA Center for Pediatric and Adolescent Clinical Trials

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Abstract

As one of 17 clinical sites of the Environmental influences on Child Health Outcomes (ECHO) IDeA States Pediatric Clinical Trials Network (ISPCTN), the Hawai'i IDeA Center for Pediatric and Adolescent Clinical Trials (HIPACT) was established in 2016 to participate in community-valued and scientifically-valid multi-center pediatric clinical trials to improve health and well-being of diverse multi-ethnic populations of Hawai'i. Hawai'i is home to large populations of diverse rural and underserved populations, including indigenous Hawaiian communities and immigrant populations of Pacific Islanders and Asians. Many of these communities experience significant health disparities, made worse by their geographic isolation and many socio-economic factors. In addition to providing opportunities for children and their families to participate in clinical trials, HIPACT's goal is to provide opportunities for junior faculty of the John A. Burns School of Medicine (JABSOM), University of Hawai'i at Mānoa, to acquire knowledge about and to develop skills in clinical trials. HIPACT's partners include the Hawai'i Pacific Health with Kapi'olani Medical Center for Women and Children, and Waianae Coast Comprehensive Health Center. HIPACT builds on the experiences gained through partnerships with the Mountain West IDeA Clinical and Translational Research-Infrastructure Network, and Research Centers in Minority Institutions Translational Research Network. Apart from participating in ECHO ISPCTN-sponsored studies, HIPACT junior faculty serve as committee members, Working Group leaders, Protocol Study Principal Investigators (PI) and site study PIs with ECHO ISPCTN. Through participation in ECHO ISPCTN, HIPACT has successfully increased the number of pediatric and maternal-fetal medicine faculty involved in the conduct of clinical trials.

Keywords

pediatric clinical trials, network, clinical research

Abbreviations

ACT NOWS = Advancing Clinical Trials in Neonatal Opioid Withdrawal Syndrome
CE = Current Experience
DCOC = Data Coordinating and Operations Center
ECHO = Environmental influences on Child Health Outcomes
ESC = Eat, Sleep, Console
HIPACT = Hawai'i IDeA Center for Pediatric and Adolescent Clinical Trials
HPH = Hawai'i Pacific Health
IDeA = Institutional Development Award
IRB = Institutional Review Board
ISPCTN = IDeA States Pediatric Clinical Trials Network
JABSOM = John A. Burns School of Medicine
NHOPI = Native Hawaiian and other Pacific Islander
NIH = National Institutes of Health
OIF = Opportunities and Infrastructure Fund
UHM = University of Hawai'i at Mānoa
VDORA = Vitamin D Supplementation in Children with Obesity-Related Asthma

Introduction

This special issue of the *Hawai'i Journal of Health and Social Welfare* on Pediatric Health and Research in Hawai'i is sponsored by the Hawai'i Institutional Development Award (IDeA) Center for Pediatric and Adolescent Clinical Trials (HIPACT) program to provide a cross sectional landscape of the research, training, education, treatment, policy and social issues related to maternal-child health in Hawai'i. The National Institutes of Health (NIH) established the IDeA program in 1993 to enhance biomedical research activities in states that have had historically low NIH grant funding success rates.¹ The program currently supports competitive research in 23 states and Puerto Rico through 4 distinct components: Centers of Biomedical Research Excellence, which targets junior faculty research mentoring; IDeA Networks of Biomedical Research Excellence, which targets undergraduate student research development; IDeA Program Infrastructure for Clinical and Translational Research (IDeA-CTR), which supports broad clinical and translational research; and IDeA co-funding, which provides support to NIH R15 or R01 applicants whose proposal received excellent rating through the peer review process but fall short of the NIH Institute or Center pay line.

As the western-most IDeA-eligible state, Hawai'i is home to large populations of diverse rural and underserved multi-ethnic populations including indigenous Hawaiian communities and other immigrant populations of Pacific Islanders and Asians who suffer geographic isolation locally, resulting in significant health inequities. Paradoxically, while 43% of the nation's children come from communities such as these, research in pediatric health disparities is lagging disappointingly behind. This is especially important in communities where the burden of disease is high and often begins in childhood. In Hawai'i, the prevalence of pediatric asthma is among the highest in the nation; nearly 20% of Native Hawaiian children have asthma. Native Hawaiian and Other Pacific Islander (NHOPI) children have high rates of obesity and associated metabolic abnormalities that are likely factors in the high rates of diabetes, cardiovascular disease, and cancer seen in NHOPI adults. While health disparities research has targeted children of African and Latin American descent, few clinical trials have focused on children from these NHOPI populations. NHOPI children are often miscategorized or pooled into the designation of "Asian/Pacific Islander". Even pooling all "Asians" into a single category to study health and disease fails to distinguish the health disparities of large com-

munities of Filipino immigrants in Hawai‘i as compared to the traditional East Asian populations. Pooling of demographic data dilutes the ability to identify health disparities specific to unique populations of young families from the Pacific Rim, and misses opportunities to develop meaningful translational and population health programs that specifically benefit those with the greatest needs. Pacific Island nations, territories, and communities with their geographic isolation and strong community foundation, offer a stable population base that may be ideal for conducting long-term longitudinal studies. Funding for HIPACT, as one of 17 clinical sites of the Environmental influences on Child Health Outcomes (ECHO) IDeA States Pediatric Clinical Trials Network (ISPCTN), enables researchers based at University of Hawai‘i at Mānoa (UHM) John A. Burns School of Medicine (JABSOM) to address these disparities.

We are delighted to be selected as one of the sites in this pediatric clinical trials network. Indeed, the ECHO ISPCTN partner institutions cover the nation’s geography from east to west, and from north to south. Moreover, ECHO ISPCTN represents a significant diversity of communities that would be difficult to duplicate in any other concept; with populations representing the spectrum of socioeconomic classes, both urban and rural. Significant numbers of people, from a wide variety of ethnic and cultural groups, including American Indians, Alaska Natives, Native Hawaiians, Asians, Hispanics, Black, and Whites, reside in the ECHO ISPCTN partner states. For many reasons, including historical events and socioeconomic factors, health disparities and inequities exist across the sites, but have been poorly studied, especially among children. As such, this new network now provides the infrastructure for multi-center clinical trials research, comparing health outcomes of geographically distinct communities across the United States, as a means to reduce pediatric health disparities among communities with the greatest needs.

This report summarizes the HIPACT Program with the ECHO ISPCTN activities that HIPACT faculty and personnel participated in during the past three years. The principal objective of HIPACT was to establish and maintain pediatric clinical trials teams in Hawai‘i to participate in large, community-valued, and consequential multi-center research as a partner in ECHO ISPCTN. The overarching goal is to improve the health and well-being of the diverse multi-ethnic populations of Hawai‘i, including those living in rural and underserved communities. This report serves as the foundation and backdrop for the special issue of the *Hawai‘i Journal of Health and Social Welfare* on Pediatric Health and Research in Hawai‘i. Through HIPACT efforts, a call for manuscripts describing the spectrum of research, teaching, service, treatment and policy related to pediatrics and maternal-fetal-medicine was released. While not intended to be all-inclusive, this report and the accompanying articles in this special issue provide a snapshot of the diverse activities related to the health and well-being of infants, children and adolescents in Hawai‘i.

Methods

Along with HIPACT, which is located at the UHM JABSOM in the Department of Pediatrics, the two clinical partners for the program are Kapi‘olani Medical Center for Women and Children of Hawai‘i Pacific Health (HPH) and Waianae Coast Comprehensive Health Center. The principal objectives of HIPACT are: (1) to launch and implement pediatric clinical trials as an ECHO ISPCTN site by providing an experienced, coordinated, and committed team of pediatric-trained personnel; (2) to engage Hawai‘i and other IDeA state communities to provide access to clinical trials including rural and underserved infants, children, and adolescents, many of whom are Asian and; (3) to contribute to the science of ECHO ISPCTN multi-center clinical trials research in disparate underserved and/or rural communities by better understanding and overcoming barriers, with the ultimate goal of improving health outcomes; and (4) to increase the number and to enhance the expertise of pediatric clinical trials faculty and their support teams through professional training and education, ultimately to expand ECHO ISPCTN research capacity.

In order to meet the goals of increasing the faculty research capacity, open invitations were announced to Departments of Pediatric and Obstetrics/Gynecology Maternal-Fetal-Medicine faculty to participate in ECHO ISPCTN activities. The ECHO ISPCTN activities included Professional Development webinars, which were hosted by the ECHO ISPCTN Data Coordinating and Operations Center (DCOC). Additionally, targeted invitation for faculty whose research interested focused on ECHO ISPCTN specific concept/protocol-specific activities and/or ECHO ISPCTN focus areas (upper and lower airway disease, obesity, pre-, peri-, and postnatal outcomes, neurodevelopment, and positive child health outcomes). The current status and accomplishments of the HIPACT Program reflect the clinical trial/research protocols that were launched in Hawai‘i as well as the ECHO ISPCTN activities in which faculty were actively engaged. Clinical research/trial protocols were reviewed and approved by the appropriate Institutional Review Board (IRB) of record (University of Hawai‘i IRB, Western IRB and/or Central IRB at University of Arkansas Medical School).

Results

ECHO ISPCTN Clinical Trials Activities in Hawai‘i

Pharmacokinetics of Understudied Drugs Administered to Children Standard of Care (POPS Study): The POPS Study (NCT01431326) was designed to better characterize the pharmacokinetics of a variety of commonly used drugs in infants and children for which limited information was available in the pediatric population.² HIPACT was one of 15 ECHO ISPCTN clinical sites which joined the POPS Study. The HIPACT Site Study PI, Dr. Venkataraman Balaraman, mentored the junior investigator, Dr. Prashant Purohit, as part of the faculty and

professional development program in HIPACT. The team, including the HIPACT Lead Coordinator (Annette Amiotte, RN), HIPACT Site Coordinator (Moara Palma), and HIPACT Regulatory Affairs Liaison (Andrea Siu), successfully launched and completed the POPS Study in Hawai‘i.

Advancing Clinical Trials in Neonatal Opioid Withdrawal Syndrome: Current Experience (ACT NOWS CE): The ACT NOWS CE study was part of a group of NIH-sponsored studies to inform the clinical care of infants who are prenatally exposed to opioids in collaboration with the Eunice Kennedy Shriver National Institute for Child Health and Human Development Neonatal Research Network and ECHO ISPCTN forming the ACTNOW collaborative (Advancing Clinical Trials in Neonatal Opioid Withdrawal). The HIPACT Site Study PI, Dr. Charles Neal, Jr., mentored the junior investigator, Dr. Akshatha, along with the HIPACT site study team, comprising the HIPACT Lead Coordinator and HIPACT Regulatory Affairs Liaison.³ A follow-up network intervention study, ACT NOWS Eat, Sleep, Console (ESC) Study is scheduled to be launched in early 2020, and HIPACT will be an active participant.

Vitamin D Supplementation in Children with Obesity-Related Asthma (VDORA Study): The VDORA Study is an ECHO ISPCTN clinical trial, which was vetted through the ECHO ISPCTN proposal review process. The study was designed to identify the optimal Vitamin D dose for children/adolescents with high body mass index and asthma to inform an interventional trial in the future. The HIPACT Site Study PI, Dr. Brian H. Wu, and HIPACT team with Research Pharmacist, Jan Vita, Regulatory-Data Coordinator, Andrea Siu, and Research Coordinator, Annette Amiotte, RN, activated the ongoing study in 2019.

ECHO ISPCTN/HIPACT Faculty Professional Development Activities

As part of the clinical trials infrastructure building for HIPACT faculty and personnel, ECHO ISPCTN Writing Committees, Working Groups and Professional Development Webinars and the ECHO Opportunities and Infrastructure Fund (OIF) Award were established to provide HIPACT faculty opportunities to improve their professional development skills.

Discussion

Through the ECHO ISPCTN, HIPACT faculty and personnel have contributed to the vision and mission of ECHO ISPCTN as a productive clinical site partner. The opportunities provided through HIPACT for faculty and personnel increased research capacity in the Departments of Pediatrics and Obstetrics/Gynecology Maternal-Fetal Medicine. It was through the ECHO ISPCTN activities that HIPACT successfully engaged junior faculty as study site PIs, ECHO ISPCTN committee members and as ECHO ISPCTN writing group members.

ISPCTN is a well-conceived network of IDeA state centers which focuses on ECHO priority areas of upper and lower airway, pre-peri-postnatal, neuro-development, obesity, and positive health. As one of the IDeA states, Hawai‘i’s underserved and rural populations benefit through the ECHO ISPCTN focus and mission which is to improve the health of underserved and rural populations of children through focused research projects. As a contributing center within the other ECHO ISPCTN clinical sites, HIPACT continues to contribute in a meaningful and proportionate effort. Building research capacity at UH JABSOM is paramount, greatly accelerated by ECHO ISPCTN’s efforts to provide professional development opportunities for junior faculty including for HIPACT faculty in the Department of Pediatrics and Obstetrics and Gynecology at JABSOM.

The ECHO ISPCTN, in three years, has evolved into a functional, productive, and scholarly network. Investigators and coordinators communicate commonly on a first name basis. Real-time teleconferences, despite time differences between network partners, are cordial and collegial. Leadership has emerged from the ranks of the partner institutions, and policies and procedures have evolved. ECHO ISPCTN has embraced not only the network partner PIs and CoPIs, but research nurse coordinators, data analysts, study site PIs, and junior investigators. Several proposals are currently ongoing or in the queue, manuscripts are being written, and some have been already published or are in press. Dozens of network partner-authored research concepts have been vetted for further consideration and two have advanced to the last stages — one of them originating from a HIPACT junior investigator. One of the proposals submitted by a HIPACT investigator in response to the ECHO OIF funding announcement was selected as the only proposal from the network moving forward for final consideration. Finally, we have been informed recently by NIH that the ECHO ISPCTN will be renewed for another five-year cycle, which we are presently actively pursuing.

The concept of the special issue was envisaged to provide opportunities for junior investigators in Hawai‘i from both academia and the community to showcase professional work focusing on pediatrics and maternal-fetal medicine in Hawai‘i. All of the manuscripts were vetted and underwent peer review by the special Editorial Board that was convened for this special edition.

Conflict of Interest

None of the authors identified any conflicts of interest.

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A Quality Improvement Project to Optimize Fluoride Varnish Use in a Pediatric Outpatient Clinic with Multiple Resident Providers

Scarlett Carmen Johnson MD and Gina Marie French MD

Abstract

The pediatric clinic at Kapi'olani Medical Center provides dental varnish to prevent decay. A chart review (conducted August 1-31, 2017) revealed that only 49.6% of eligible children received varnish. Among those who did not receive varnish, no explanation was provided in 83.9% of the charts. This quality improvement project was designed to increase delivery and documentation of dental varnish. The participants were 14-15 pediatric and psychiatry residents (11 present for all cycles). Cycle 1 interventions were a 5-minute resident educational session on the importance and process of fluoride varnish, and visual reminders on all order entry computers in the clinic. Cycle 2 intervention consisted of a prompt added to the clinic's default well child visit templates requiring notation of whether varnish was given and a reason if not. Data for cycle 2 was collected over 6 weeks as some residents chose to use their own templates, serving as an unplanned comparison group. Application of varnish increased to 77.7% ($P < .001$) after cycle 1, and was statistically unchanged for cycle 2 (74% ($P = .24$)). Documentation of reason for lack of varnish was missing in 80% ($P = .59$) after cycle 1 and 17% ($P < .001$) after cycle 2 (with prompt). In the cycle 2 comparison group using their own templates, the varnish application rate was 71% ($P < .001$) with no explanation for lack of varnish 84% of the time ($P = .95$). Brief educational interventions may result in increased use of fluoride varnish in resident-based clinics. Task based prompts or stop measures in electronic medical record templates can improve documentation, which can inform efforts to improve varnish application.

Keywords

fluoride varnish, quality improvement, educational intervention, early childhood caries, resident clinic

Abbreviations

AAP = American Academy of Pediatrics
CDC = Centers for Disease Control and Prevention
EMR = Electronic medical record
KMCWC = Kapi'olani Medical Center for Women and Children
PCP = Primary care physicians
PDSA = Plan-Do-Study-Act
QI = Quality improvement
USPSTF = United States Preventative Services Task Force
WCC = Well child checks

Introduction

Early childhood dental decay is the most common chronic disease of preschool children, estimated to affect up to 22.7% of 2-5 year-olds in a 2011-2012 study¹ and up to 53% in those 6-8 years old.² Fewer than 50% of young children received dental care in 2009, with only 7% of those ages 0-2 years old and only 43% of those ages 3-5 years old having access to dental care.³ According to Bright Futures, the younger the age

at which tooth decay begins, the greater the severity as well as the risk of future decay.⁴ The Hawai'i State Department of Health in 2014-2015 collected data from elementary schools and found that Hawai'i third graders have the highest prevalence of caries in the nation (71% vs the national average of 52%). Among children living in Hawai'i, there are significant disparities with Pacific Islanders and children living in poverty at highest risk.⁵ The Centers for Disease Control and Prevention (CDC) reports that 60.9% of Hawai'i's Head Start students have dental caries.⁶ This economic disparity is consistent with national data where nearly two-thirds of children under 200% of the federal poverty level experience caries in their primary teeth by 8 years old.² At least part of the disparity between the dental health of Hawai'i's children and that of the rest of the nation can be attributed to the lack of community water fluoridation. The CDC lists community water fluoridation as one of the 10 great public health achievements of the 20th century due to its reduction in childhood tooth decay (40%-70%) and in adult tooth loss (40%-60%).⁷

Children under the age of 5 years are more likely to be seen by primary care physicians (PCP) than dentists.² The children who are seen in the pediatric residency outpatient clinic are at particularly high risk of dental disease. Over 90% are on public insurance, and over 50% of the families are Pacific Islander. Anecdotally, they have difficulty accessing dental care, particularly before the age of 3. Oral fluoride supplementation (with suboptimal systemic rather than topical delivery of fluoride) is a poor substitute for water fluoridation as it requires a prescription and family adherence.

There is substantial evidence that fluoride varnish can prevent the development of dental caries. Prior systematic reviews have found that fluoride varnish may decrease caries in permanent dentition by up to 38%,⁸ and can reduce decayed and filled tooth services by up to 37%.⁹ It can even reverse early carious lesions,¹⁰ and is recommended by the American Academy of Pediatrics (AAP), the American Academy of Pediatric Dentistry, the CDC as well as the US Preventative Services Task Force (USPSTF). Several organizations such as the AAP have free online oral health risk assessment questionnaires that PCPs may utilize should they need help in determining who is at high risk of dental caries. The USPSTF has recommended since 2016 that fluoride varnish be applied in the primary care setting 2-4 times per year. Application involves painting of topical fluoride on teeth with a small brush. It takes from 1-5 minutes to apply; families are asked to eat soft foods and not drink hot liquids

or brush their teeth for several hours afterwards.^{2,11} Reported barriers to implementation include time constraints, lack of oral health training, parental refusal, and concerns about financial costs to the practice due to impaired work flow.²

Fluoride varnish is covered by most private insurers and has been covered by Medicaid in all states since 2017.^{2,12} A Monte-Carlo cost-benefit simulation by Scherrer & Naavaal found that applying this resource to Medicaid insured children under 3 years old in Virginia could reduce the proportion of 7.5-year-olds with decay from 63.2% to 39.8% and save Virginia Medicaid \$75.32 per child, an estimated \$2 million per year.² Accounting for application time and labor and material costs, the return on investment for fluoride varnish was deemed to be 4-12 times the direct fluoride varnish application cost. Prior oral health prevention initiatives have shown via cost/revenue analysis that such programs can contribute to the financial viability of a clinic.¹³ The average reimbursement rate for fluoride varnish is \$18.90.² Reimbursement in Hawai'i is \$4.16 per application up to twice a year.¹⁴

Kapi'olani Medical Center for Women and Children's (KM-CWC) outpatient pediatric clinic is primarily staffed by residents who are overseen by attending physicians. Fluoride varnish has been available in the clinic since 2013 and is provided free of cost to the patients, but anecdotally seemed to be underused. The clinic's goal is to offer varnish at well visits up to every 3 months to children between the age of 6 months and 5 years. Prior studies have documented success with educational interventions as well as alteration of the electronic medical record (EMR), ultimately increasing varnish application rates as well as dental referrals.^{15,17} However, these studies were not conducted in populations such as Hawai'i where children are at higher risk due to lack of fluoride in the public water. The authors sought to utilize quality improvement (QI) methods to increase fluoride varnish application to reach 85% of eligible well checks at the clinic.

Methods

A pre-intervention chart review of eligible Well Child Checks (WCC) over a 1-month period (August 1-31, 2017) was conducted to assess current fluoride varnish application rates. An eligible WCC was defined as a patient between the ages of 6 months to 5 years old who had teeth and who had not received fluoride varnish within the preceding 3 months (either on review of clinic visits in EMR or per parental report). This age group was in alignment with the recommendations of the USPSTF.⁹ There are 9 scheduled well child checks in this age range, during which time children typically lack an established dental home, providing ample opportunity for intervention. Due to the high percentage of Pacific Islander patients and patients on Medicaid, it was decided that most of the patients are high risk. Therefore, a formal risk assessment was not performed. To minimize collection of patient identifiers, individual insurance

coverage and ethnicity information were not collected. This study was reviewed by the Hawai'i Pacific Health Institutional Review Board and found to be exempt (2017-130).

Three residents were shadowed in clinic and subsequent discussion regarding missed fluoride varnish opportunities revealed time, distraction, and lack of knowledge as potential barriers. The team then sought to assess all residents' understanding regarding fluoride varnish objectives. Subsequently, 22 of the 24 pediatric residents (excluding the two residents involved in the project) were surveyed pre-intervention to assess knowledge and confidence about clinic goals of fluoride varnish use (Figure 1). The resident survey revealed that 18% (4/22) were not at all confident about their varnish knowledge or when to apply it. Although 36% (8/22) were fairly to very confident about their knowledge, only 23% (5 out of 22) correctly reported the clinic's target varnish frequency of every three months. Fifty-five percent (12 out of 22) knew the clinic's target age range. The results of both the survey and observations were used to identify secondary drivers in the key driver diagram (Figure 2), which the authors used to develop interventions. While the framework of a key driver diagram is standard among many QI references, the content used to fill it in were the authors' own creation.¹⁶

The intervention ideas developed from the key drivers were implemented using a Plan-Do-Study-Act (PDSA) approach. PDSA is a cyclical process that allows observation of a current approach to pursue opportunities for improvement. It proceeds with establishment of baseline function or data, an intervention identified based on a specific aim or goal with defined measures, and a subsequent assessment of effect with either ongoing adoption of the test change or adaptation and repetition of the cycle. It often entails small and frequent interventions for quick adjustment that can then be applied on a larger scale.¹⁶ The first PDSA cycle consisted of a 5-minute-long resident educational session via PowerPoint highlighting research on the impact of fluoride varnish on dental health and specifying clinic goals for use, coupled with bright orange reminders taped to the bottom of the monitors of all order entry computers. The residents were encouraged to ask if the patient had received varnish within the last three months to determine eligibility. There was no standardization in how the topic of varnish was broached with parents. A chart review was conducted after one-month of implementation (February 1-28, 2018) and the percentages or proportions of varnish delivery were calculated.

PDSA cycle 2 consisted of incorporation of a dental health history section and a fluoride varnish prompt into the plan section of default Epic EMR WCC templates. All well visits (6 months-5 years) contained the same varnish prompt which requires the physician to either fill in the information or delete the section to close the encounter. Providers simply had to click a yes or no drop-down option. If they selected "no varnish" the three asterisks encouraged them to fill in the reason why it was not

RESIDENCY YEAR (i.e. PGY1) _____

How confident do you feel about your knowledge of fluoride varnish and when to use it? (circle)
 Not at all confident somewhat unconfident neutral fairly confident very confident

Technically fluoride varnish can be applied at any age. For what age range is fluoride varnish recommended in our clinic to help minimize early childhood caries?
 a) 12 months – 4 years b) 9 months – 6 years c) 6 months – 5 years d) 4 months to 4 years

You can varnish any number of teeth (circle) TRUE FALSE

At KMCWC Clinic, how frequently can fluoride varnish be applied?
 a) As frequently as you want b) every year (q12 months) c) every 6 months d) every 3 months

Figure 1. Survey Distributed to Hawai'i Residency Program Pediatric Residents

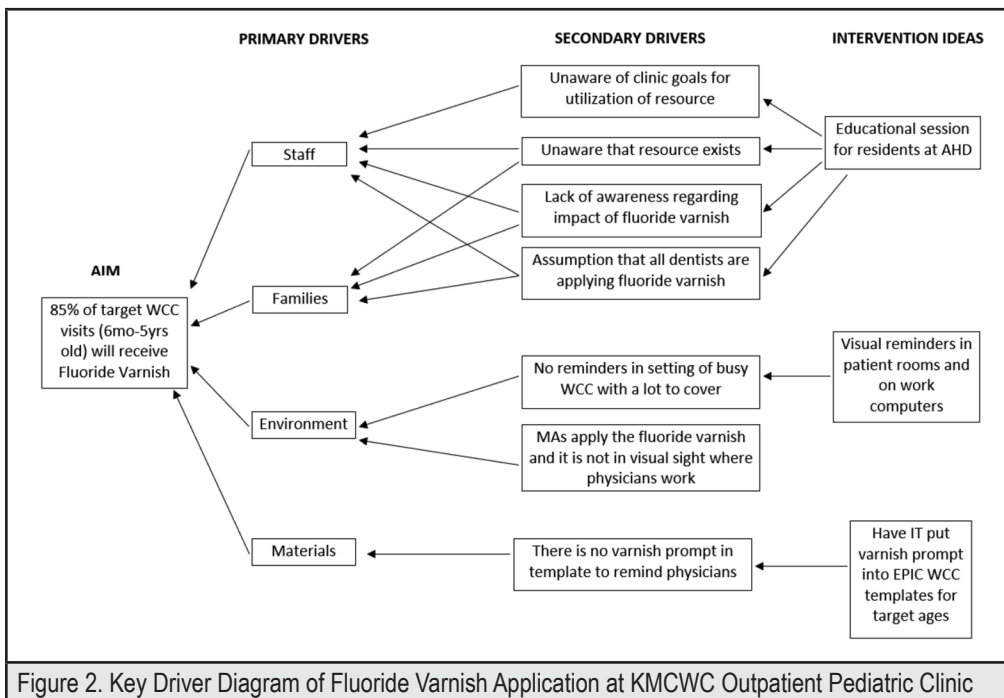


Figure 2. Key Driver Diagram of Fluoride Varnish Application at KMCWC Outpatient Pediatric Clinic

delivered. Standard templates were available to all clinic physicians and simply required typing “WCC” followed by the age of the well child check (ie, “WCC6mo” for a 6-month WCC) where the template would then auto-populate. All residents were encouraged to use the new template; however, a subset of self-selected residents opted to continue to use their own previously created personalized templates that did not have the prompts. The chart review after PDSA cycle 2 consisted of a 1.5-month period (March 1 to April 15, 2018), to allow for a larger sample size in response to the reduction in the number of residents using the new standard template.

Participants were 14-15 pediatric and psychiatry residents (11 present for all cycles). Variables collected included date of visit, age, sex, whether the patient had seen a dentist in the year

prior, varnish application within the last three months, and any documentation for why varnish was not applied. We used the χ^2 test of independence with $\alpha = .05$ as criterion for statistical significance to look for differences in proportions between groups. Analysis was conducted using SAS software, version 9.4 (SAS Institute Inc.: Cary, NC).

Results

The age distributions in the pre-intervention, PDSA cycle 1 and 2 samples differed, with overrepresentation of 6-12-month-olds and under representation of 2-5-year-olds in cycles 1 and 2 ($\chi^2(4, N=603)=11.34, P=.02$) (Table 1). Of the eligible visits ($N=202$) in the pre-intervention chart review, 49.6% were varnished (Table 2). There was no documentation of a reason in

	Pre-Intervention N (%)	PDSA Cycle 1 N (%)	PDSA Cycle 2 N (%)
Total WCC*	202 (100)	157 (100)	244 (100)
Age 6-12 months old	44 (21.8)	44 (28)	85 (34.9)
Age >1 yr to 2 yrs old	80 (39.6)	67 (43)	85 (34.9)
Age >2 yrs to 5 yrs old	78 (38.6)	46 (29)	74 (30.3)
Total unvarnished	112 (100)	35 (100)	67 (100)
Parental refusal	7 (39)	3 (43)	10 (30)
Deferred to dental visit	10 (56)	2 (28)	23 (70)
The family left or provider did not place the order	1 (5)	2 (28)	0 (0)
No explanation	94 (84)	28 (80)	33 (49)

PDSA = Plan-Do-Study-Act. WCC = Well child check.

* $\chi^2(1, N = 359) = 40.15, P < .001$. Comparing all three groups: * $\chi^2(4, N = 603) = 11.34, P = .02$.

	Pre-Intervention N (%)	PDSA Cycle 1 N (%)	PDSA Cycle 2 N (%)	Cycle 2 with varnish prompt N (%)	Cycle 2 without varnish prompt N (%)
Total WCCs	207	160	275	159	116
Total WCCs (% male)	(44)	(51)	(42)		
Eligible who had not seen a dentist in the last year**	(51)	(31.6)	(48)	(42)	(56)
*Eligible WCCs	202	157	244	135	109
Offered fluoride varnish	108 (53.5)	159 (96)		129 (96)	89 (75)
*Eligible varnished	90 (44.6)	122 (78) [†]	177 (72.5)	100 (74) [^]	77 (71) [‡]
*Eligible unvarnished with no documented reason	94 (84)	28 (80) ^{††}	33 (49) [#]	6 (17) ^{^^}	27 (84) ^{§‡}

* Eligible patients were defined as those between 6 months and 5 years old, with teeth and whom did not receive fluoride varnish within the last three months

** Due to the recommendation that the first dental visit occur at age 1, this does not include the 12, 9 and 6 months well child check patients

Compared to pre-intervention group: [†] $\chi^2(1, N = 359) = 40.15, P < .001$ ^{††} $\chi^2(1, N = 147) = 0.2916, P < .59$

[^] $\chi^2(1, N = 337) = 28.67, P < .001$ ^{^^} $\chi^2(1, N = 70) = 27.67, P < .001$ [§] $\chi^2(1, N = 144) = 0.0037, P = .95$

Compared to cycle 1: [#] $\chi^2(1, N = 401) = 1.34, P = .24$

Compared to cycle 2 with varnish prompt: [‡] $\chi^2(1, N = 67) = 30.23, P < .001$ ^{‡‡} $\chi^2(1, N = 244) = 0.3566, P = .55$

PDSA = Plan-Do-Study-Act WCC = Well child check

84% of the unvarnished. There were 157 eligible visits in PDSA cycle 1, 22% of which did not receive fluoride varnish. There was no explanation for the omission in 80% of the unvarnished patients. There was a statistical difference between preintervention and cycle 1 varnish rates ($\chi^2(1, N = 359) = 40.15, P < .001$) but not documentation rates ($\chi^2(1, N = 147) = 0.2916, P < .59$).

In PDSA cycle 2 (N=244), 135 were documented on the updated template and 109 were on personalized templates without the varnish prompt. In those with the prompt, 74% were varnished; there was no explanation for omission in 17% of those unvarnished. In those who used a template without a varnish prompt 71% received fluoride varnish and there was no explanation in 84% of unvarnished. There was a statistically significant difference in varnish rates ($\chi^2(1, N = 337) = 28.67, P < .001$) as

well as documentation rates between the preintervention group and the cycle 2 group that used the new template with varnish prompt ($\chi^2(1, N = 70) = 27.67, P < .001$). There was no statistical difference in documentation rates comparing preintervention to cycle 2 where residents used their own template without the fluoride varnish prompt ($\chi^2(1, N = 144) = 0.0037, P = .95$). The cycle 1 and cycle 2 varnish rates were not significantly different ($\chi^2(1, N = 401) = 1.34, P = .24$). However, when comparing the two groups in PDSA cycle 2, there was a statistically significant difference in documentation rates ($\chi^2(1, N = 67) = 30.23, P < .001$) but not varnish rates ($\chi^2(1, N = 244) = 0.3566, P = .55$). For those unvarnished with some explanation, the most common reason was deferral to dentist followed by parental refusal (Table 1). In the majority of cases, there was no documentation of why the parent refused.

Discussion

The significant improvement in varnish application from 44.6% (pre-intervention) to 74%-78% in the PDSA cycles fell short of the goal of applying fluoride varnish in 85% of eligible WCC. However, the improved documentation in PDSA cycle 2 revealed that it had been offered to 95% of families. Varnish application was limited primarily by the presence of a dental home or parental preference.

The WCC visit can be difficult to navigate, especially for the new learner, imparting a large breadth of information over a relatively brief time. Education and visual reminders remain important tools for increasing preferred practices, especially one such as fluoride varnish which is not universally offered in the outpatient clinic setting or traditionally associated with the WCC visit. The effectiveness of educational interventions to promote fluoride varnish by pediatric residents has been demonstrated previously.^{15,17} The QI project demonstrated the effectiveness of an exceptionally short educational session when coupled with EMR templates and visual reminders.

Given the decline (albeit statistically insignificant) in application noted between PDSA cycle 1 (78%) and the PDSA cycle 2 comparison group (no varnish prompt) (71%), it may be that educational interventions require periodic reinforcement. The increase in varnish application between PDSA cycle 2 comparison group (no EMR prompt in template) and pre-intervention chart review may be partly explained by the overlap in residents between PDSA cycle 1 and cycle 2. Patients in the clinic frequently see different providers for their visits. Incorporation of target objectives into the EMR may improve care by enabling clear communication among numerous providers regarding a prior refusal or omission; this may allow the subsequent physician to plan for time to address fluoride hesitancy if needed. The authors hope the EMR changes help the program persist in its increased use of this dental resource.

There are several limitations to this project. Because the clinic had already committed to offering varnish, the authors did not quantify the time commitment applying fluoride varnish required, which was a barrier to implementation identified by previous studies.^{19,20} The application of varnish can be completed within a few minutes; however, the family does have to wait for the medical assistant to get the varnish. In addition, the amount of information provided or the way it was conveyed to parents was not standardized, and there was likely great variability in the way parental refusal was handled.

When the authors realized that certain residents were using their own template without a varnish prompt, the chart review period was extended to 6 weeks instead of 4 to achieve a larger sample size. The authors were interested in comparing the two cycle 2 subgroups but this may have introduced a temporal bias.

PDSA cycle 2 utilizing an EMR varnish prompt in the WCC template resulted in the best documentation rate but it is not a perfect system. It can be easily bypassed by simply deleting that section. Residents were not forced to use a certain template. While this allowed an opportunity to compare those who continued to use their own template without an EMR varnish prompt to the new template, this may have introduced some bias as residents using their own templates may differ (ie, personal attitudes about fluoride varnish). Residents who continued to use their own template may have done so out of reluctance to invest the time to change the default template to meet their preferences. Requiring incorporation of the prompts in the future may improve varnish rates and documentation. Finally, many physicians do not refer to the computer while conducting the WCC. They may see the prompt too late to affect care, which may explain the failure to further increase varnish application.

PDSA cycle 1 likely had effects that persisted into cycle 2. The posted visual reminders that fell after PDSA cycle 1 were not replaced. Most, but not all, of the well children are seen by a resident. The attending physicians receive a different online training that is repeated every year to qualify for reimbursement. A research study might include randomization of providers but the purpose of this project was QI and not research testing a novel clinical intervention. The timing of this project was short, in part due to the time-consuming nature of the chart review. Longer observations would better account for any month to month variability and allow providers to determine if improvements persist over time. The temporal nature of PDSA cycles make it possible for other contributing factors, other than the interventions, in explaining the improvement (eg, time in residency). This study did not collect data on resident demographics or patient demographics such as socioeconomic status and ethnicity.

Additional opportunities for improved fluoride varnish application going forward include reinforcement educational sessions for residents, replacement of missing visual reminders and addressing the way in which fluoride varnish is offered to families, and how resistance or hesitance to its application are explored with parents. Since parental refusal has been recognized as a reason why fluoride varnish is not applied,¹⁸ future PDSA cycles could address the reasons for refusal.

Fluoride varnish is cheap, quick, and easy to apply. There is extensive data to suggest it can improve dental health and a child's overall wellbeing. Frequent visits to pediatricians during infancy and early childhood provide an opportunity to affect a child's dental health until, or in addition to, the establishment of a dental home. Education, visual reminders, and prompts may help busy pediatricians increase the delivery of this valuable preventative care. Better documentation from an EMR prompt improves communication between providers and can inform the ongoing efforts to improve performance.

Conflict of Interest

None of the authors identify a conflict of interest.

Disclosure Statement

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Pediatric Simulation Training for Emergency Pre-Hospital Providers in Hawai'i: An Inter-Professional Curriculum Collaboration and Update

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Abstract

Experience with pediatric transport and pediatric-specific training for paramedic students and practicing paramedics is lacking nationally. Kapi'olani Community College (KCC) conducts the only paramedic training program in the state and has recently expanded its pediatric training section. KCC and the John A. Burns School of Medicine (JABSOM) collaborated on a simulation-based pediatric pre-hospital provider training course titled PediSTEPPs-H (Pediatric Simulation Training for Emergency Pre-hospital Providers in Hawai'i), which was developed and piloted in 2019, to supplement the students' didactic and clinical experiences. The program was developed using Kern's 6-step approach to curriculum development in medical education. The PediSTEPPs-H pilot course was co-facilitated by faculty from both campuses and enrolled 12 students in the first cohort. Program evaluation demonstrated high student satisfaction and included feedback regarding curriculum elements for further refinement. The PediSTEPPs-H pilot program evaluation provided direction that the course be offered annually for all KCC paramedic students and as continuing professional development program for practicing paramedics in Hawai'i.

Keywords

Simulation, Inter-professional education, Pediatrics, Pre-hospital providers, Paramedics, Emergency medical services

Abbreviations

CE = Continuing education
EMS = Emergency medical services
JABSOM = John A Burns School of Medicine
KCC = Kapi'olani Community College
MICT = Mobile Intensive Care Technician
PALS = Pediatric Advanced Life Support
KMCWC = Kapi'olani Medical Center for Women and Children
NREMT = National Registry of Emergency Medical Technicians

Introduction

The Kapi'olani Community College (KCC) Mobile Intensive Care Technician (MICT) or Paramedic Program was started in 1988. Prior to that, a state agency at The Queens Hospital conducted the certification program. Currently, there are 3 teaching sites for the KCC MICT Program – O'ahu, Maui, and Hawai'i Island. Students are employed prior to joining the program and continue their employment with their respective agencies upon graduation. These agencies include the City and County of Honolulu, Hawai'i County Fire Department and a private ambulance service. Each agency follows Hawai'i state

standing orders to guide actions and define the paramedic scope of practice. These orders are age- and condition-specific and include drug dosages, indications for procedures, and guidance on communication with medical command. The KCC MICT Program consists of 16 courses, 2 of which focus on pediatrics and other special populations. The pediatric curriculum didactic portion includes the American Heart Association Pediatric Advanced Life Support (PALS) and the Emergency Pediatric Care courses. The recently expanded clinical component includes rotations at the Kapi'olani Medical Center for Women and Children (KMCWC) in the emergency department, pediatric intensive care unit, the pediatric outpatient clinic, and operating room. During clinical experiences, the KCC MICT students learn alongside other trainees, including residents, medical, and nursing students. Paramedic trainees report being less directly involved during their training in the care of pediatric patients, even during pediatric-specific rotations, compared to other clinical training experiences.¹ In these rotations, students perceived that priority for direct patient care, procedures, and decision-making was given to other trainees including nursing, medical students, and residents. KCC MICT students likely face similar barriers at KMCWC, which is a teaching site for the University of Hawai'i at Mānoa Nursing School, John A Burns School of Medicine (JABSOM), and Hawai'i Residency Programs for Pediatrics and Family Medicine.

Curriculum Development and Program Evaluation

The KCC MICT faculty, while expanding their pediatric curricula, collaborated with the directors of the JABSOM SimTiki Simulation Center, which included a pediatric emergency medicine physician from KMCWC. To apply Kern's 6-step approach to curriculum development for medical education, the first step was problem identification by the KCC MICT faculty when they approached the pediatric emergency medicine physician about improving and expanding pediatric education for the KCC MICT Program.²

The second step was performing a curriculum needs assessment, including literature search, local data analysis, and local expert consensus. Nationally, emergency medical services (EMS) responses to pediatric patients most often include traumatic injuries and respiratory complaints; therefore these topics were

included in the course.³⁻⁹ In 2018, in keeping with national data, trauma-related calls made up 27.5% of pediatric transports by the City and County of Honolulu EMS (personal communication with Assistant Chief of Professional Standards City and County of Honolulu EMS Division). Drowning was identified as the trauma topic most relevant to local EMS providers given the unique local conditions of beach environments, large tourist population, and year-round warm weather allowing for swimming pool activities. While EMS providers are in a distinct position to observe and report suspicions for child abuse, a lack of training, resources, and knowledge about child abuse have been identified as barriers to recognition and reporting.¹⁰ A child abuse module was therefore included in the curriculum. Communication challenges between providers, especially at transitions of care and with the child/family, have been identified to be threats to patient safety in the pre-hospital setting; therefore, elements addressing these topics were included.¹¹ The KCC MICT faculty identified the commonly encountered problem of pediatric seizure and the low frequency, high-risk event of pediatric shock as important topics for the course. Finally, pediatric drug dosing was included, as it is notoriously challenging; practicing EMS providers identify medication errors as a threat to patient safety and medication errors are a frequent root cause of errors in pre-hospital simulations.^{11,11-14}

The third step of developing curricular goals and objectives was conducted collaboratively by KCC MICT faculty and the SimTiki directors. The course had the following goals: (1) increased awareness and confidence with pediatric evaluation and assessment, and (2) improved communication and teamwork when dealing with pediatric patients. Objectives identified to support the achievement of the goals included the following learner behaviors: (1) to prioritize assessment and interventions in pediatric emergencies, (2) to develop a broadened differential diagnosis for pediatric chief complaints, (3) to calculate correct drug dosages for pediatric patients, (4) to anticipate and prepare for patient care at the receiving facility, and (5) to verbally communicate with inter-professionals over medical command radio and at handoff.

The fourth step in curriculum development was to select an educational strategy to accomplish the goals and objectives. The KCC MICT faculty and the SimTiki directors elected to design a 1-day simulation-based educational course, with interactive debriefing and short lecture to supplement the didactic and clinical portions of the existing pediatric curriculum. Simulation is a well-matched educational strategy for pre-hospital medicine topics and has been used to identify specific cognitive, knowledge, and psychomotor skill deficiencies in practicing paramedics.¹⁵ Cognitive, procedural, systems, and teamwork errors have been identified using simulation-based pediatric training with debriefing, yielding opportunity for enhanced education and training outcomes.^{12,13} Realistic, simulation-based training that is locally-provided and primarily hands-on has been identified by practicing pre-hospital providers as the

most effective method of continuity training.^{11,16} The structure and content of our course were based on a previously published simulation course for pre-hospital providers from Texas Children's Hospital titled *PediSTEPPs Pediatric Simulation Training for Emergency Pre-hospital Providers*.¹⁷ Interactive lecture with image identification and discussion were selected as the most efficient educational strategy for the child abuse content of our course. Four simulations were developed to address the objectives, using the medical problems of asthma, seizure, drowning, and septic shock. Participants were paired in 2-person teams to manage simulation cases, mimicking real-world pre-hospital conditions; equipment, medication, and supplies were limited to that which are routinely available in EMS packs and ambulances. Participants completed a pre-training quiz consisting of 12 multiple-choice questions that were based on Hawai'i State Standing Orders for pediatric patients and on published PALS guidelines. This served to establish the participants' perceptions of relevance and need for the training.

The fifth step of curricular implementation took place in April of 2019, with a cohort of 12 KCC MICT students. See Figure 1 for the course outline. All participants were simultaneously enrolled in the KCC MICT Program and employed as emergency medical technicians (EMT); 11 by the City and County of Honolulu EMS and 1 by a private ambulance service. At the time of the course, they had completed the didactic and clinical portions of the program's standard pediatric rotation. Participants were instructed to review and reference the Hawai'i State Standing Orders for pediatric patients before and during the course. All participants completed the pre-course quiz; the average score was 66%. In a 3-hour morning session, learners sequentially completed 2 simulation exercises, each followed by a debriefing and engaged in the child abuse lecture and discussion. In a 3-hour afternoon session, learners participated in 2 additional simulation cases followed by debriefings. Between simulations, participants participated in a round table discussion of difficult topics led by the KCC MICT faculty.

The final step of Kern's approach to curriculum development, feedback and evaluation, was accomplished by administering an anonymous online post-course survey for all participants. The participants reported low frequency contact with pediatric patients in their regular practice, with 100% caring for 0-3 pediatric patients per month, consistent with national provider self-reports of pediatric patient encounter rates.^{16,18,19} See Figure 2 for learner responses on level of course. Participants unanimously agreed that practicing paramedics would benefit from the course, but they differed in how frequently the course should be offered; answers ranged from once a month to once a year. Participants valued the in-course physician interactions, both during the communication exercises and while receiving external feedback on assessment and management during scenarios and debriefing. Inter-professional interaction with physicians was specifically referenced by 75% of participants as the most valuable part of the training.

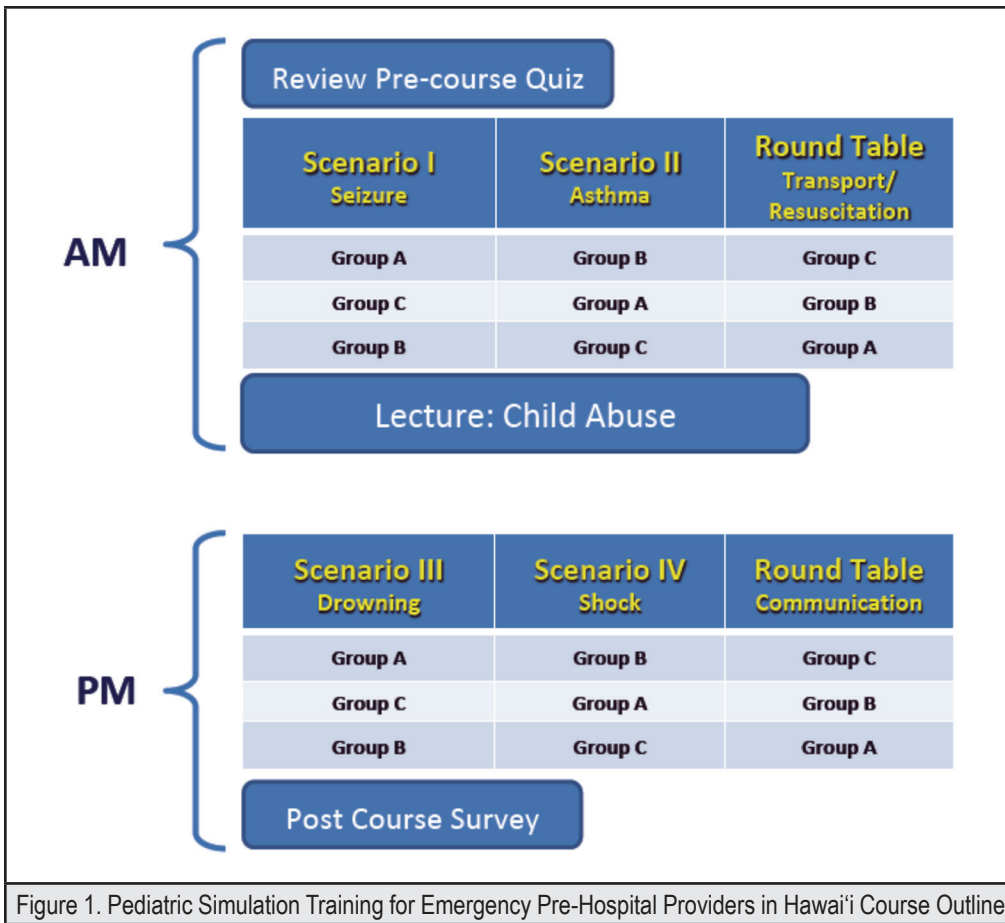


Figure 1. Pediatric Simulation Training for Emergency Pre-Hospital Providers in Hawai'i Course Outline

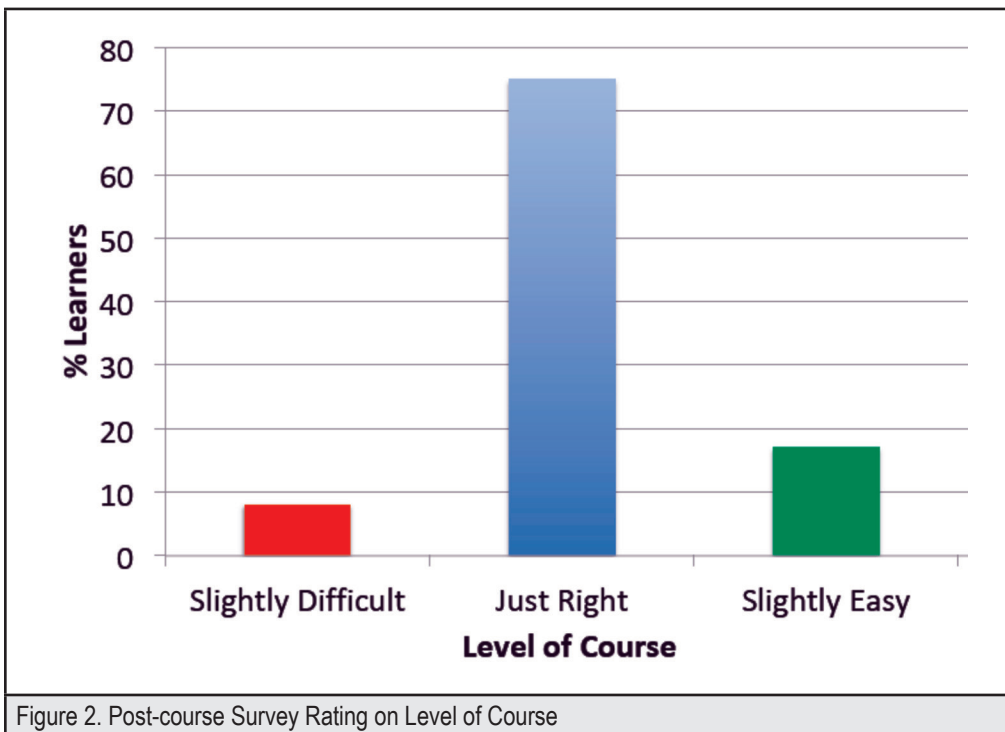


Figure 2. Post-course Survey Rating on Level of Course

Discussion

KCC MICT faculty speculated that the inter-professional interaction would be a highly-valued component of the PediSTEPPs-H training. The KCC MICT faculty had observed that real-time feedback and follow-up from emergency department providers to the pre-hospital providers had become non-existent in the local community. This was attributed to the nature of emergency department operations, pre-hospital provider requirements to transition patient care quickly, and to resume work by getting ambulance crews back on the road. Pre-hospital providers have identified deficits in communication as a threat to patient safety and suggested development of opportunities for interaction with emergency department staff as a method to address these deficits.^{11,20} This curriculum directly addressed the inter-professional communication deficit and was identified by the participants in open-ended comments as the most highly-regarded element of the course.

Participant learners in this cohort were KCC MICT students, in the process of achieving paramedic certification, and will continue to work for their current agencies following paramedic certification. Paramedic recertification is required every 2 years, achieved by maintaining National Registry of Emergency Medical Technicians (NREMT) certification or by submitting evidence of continuing education (CE) at the state level. Currently, the NREMT 2016 National Continued Competency Program requires 3.5 hours of pediatric-specific CE every 2 years to re-certify and the state of Hawai'i does not have a pediatric-specific CE requirement.^{21,22} National surveys of EMS for Children State Partnership grantee program managers have identified that limitations in funding, time, instructors, and accessibility are all barriers to engagement in pediatric education for pre-hospital providers.²³ Gaps or inadequacies in continuing pediatric education have been identified by practicing pre-hospital providers as threats to patient safety.^{11,20}

There are 145 paramedics who staff the 21 advanced life support ambulances operated by the City and County of Honolulu EMS division. In 2018, there were 1796 pediatric transports by the City and County of Honolulu EMS, comprising only 3% of total transports (personal communication with Assistant Chief of Professional Standards City and County of Honolulu EMS Division). Of these pediatric transports, 77% were categorized as advanced life support transports. Pediatric patients, as defined by the City and County of Honolulu EMS, are those who are 14 years or below. This level of pediatric experience averages approximately 1 pediatric patient per month per provider, similar to the self-reported contact with pediatric patients reported by the KCC MICT student cohort in our course, and as reported in national surveys of practicing pre-hospital providers. Analyses of large EMS databases nationally demonstrate that children comprise between 4%-13% of pre-hospital responses.^{5,6,24,25} The age criteria for children in these databases were typically ages 19 years and below, which likely explains the comparatively lower percentage of pediatric patients in the Honolulu EMS report. Advanced life support skills and critical care procedures are employed infrequently during pediatric transports.^{3,6} Skills such as intravenous medication administration, defibrillation, cardioversion, cardiac pacing, cardiopulmonary resuscitation, endotracheal intubation, cricothyroidotomy, needle decompression, pericardiocentesis, intraosseous, or central venous catheter placement are reported between 1-14% of pediatric transports.^{3,6-8} Of these advanced skills and procedures, intubation is one

	Honolulu EMS	National EMS
Pediatric prehospital response rate	3%	4%-13%
Pediatric intubation attempt rate	1.1%	0.33%-0.67%
Pediatric intubation success rate	70%	76.2%-81.1%

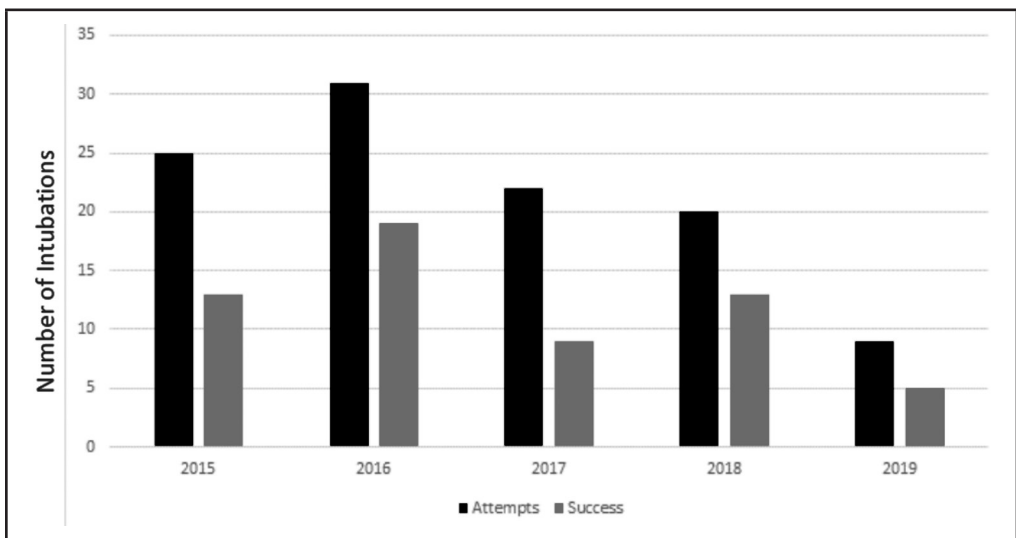


Figure 3. City & County of Honolulu EMS Pediatric Intubations

of the more frequently reported, occurring in 0.33-0.67% of pediatric transports, with a success rate between 76.2% [95% CI=74.7–77.7] to 81.1% (95%CI=79.7–82.6).^{3,26} City and County of Honolulu EMS intubation attempts occurred at a rate of 1.1% in 2018, with a success rate of 70%; again, noting that these were in patients aged 14 years or younger. See Table 1 for a comparison of Honolulu EMS pediatric transports to national data on intubation.^{3,26} However, best current evidence suggests that out-of-hospital endotracheal intubation is not associated with more favorable neurologic outcomes compared to bag-mask ventilation and intubation attempts over the last 3 years have decreased.²⁷ See Figure 3 for City and County of Honolulu EMS pediatric endotracheal intubation trends provided by the Assistant Chief of Professional Standards City and County of Honolulu EMS Division.

Discrepancies in pre-hospital documentation and assessment between adult and pediatric patients have been described; children are less likely to have complete vital sign assessment and pain score documentation than adults presenting with similar complaints.⁹ Perceptions of pediatric calls have been described as “very high risk, very low frequency.” Lack of individual experience to inform and guide emergent and urgent pre-hospital management leads providers to associate concomitant anxiety and complexity as contributors to patient safety threats.¹¹ Self-described discomfort and anxiety with pediatric patients, combined with a lack of experience and training, have been consistently identified as contributors to patient care errors.^{1,28,29} Integration of this course as a routine component of the KCC MICT Program to augment existing pediatric didactics and clinical rotations appears to be warranted based on learner and faculty perceptions. Expanding the course and offering CE credits to practicing paramedics is arguably a higher priority since they do not routinely encounter critically ill pediatric transports and are distant in time from exposure to pediatrics during paramedic training. Future iterations of this course, with larger numbers of learners, will allow assessment of more advanced educational outcomes including self-efficacy, specific skill performance, and broader knowledge assessments.

Qualitative studies surveying practicing pre-hospital providers on barriers to and resources for improving the care of pediatric patients identify the need for more frequent pediatric training, including opportunities for external feedback, and for improved interactions with emergency department staff.^{20,30,31} The quality of available pediatric training has been identified as the foremost barrier to additional training and PALS was identified as the most commonly reported pediatric-specific ongoing training for practicing pre-hospital provider.¹⁶ PALS content provides an important knowledge base in an educational format of lectures and basic simulation, which are not identified by providers as their most effective method of training. Currently, PALS is the most common pediatric-specific CE activity completed by City and County of Honolulu EMS practicing paramedics. Providers are in favor of mandated pediatric CE; however, cost, avail-

ability, and travel distance have also been identified as barriers to obtaining this training.¹⁹

Conclusion

This KCC and JABSOM collaborative pilot program has demonstrated proof of concept, high learner satisfaction, and is aligned with the pediatric-specific goals and objectives of the State of Hawai‘i Department of Health Emergency Medical Services Division. Integrating PediSTEPPs-H in the regular pediatric curriculum for the KCC MICT Program and expanding the offering annually with CE credits for practicing paramedics annually are priorities that depend on adequate funding and leadership support. Future directions for investigation may include paramedic program feedback and evaluation, self-efficacy surveys for participants, performance outcome measures, and expansion of needs assessment for additional training.

Conflict of Interest

None of the authors identify a conflict of interest.

Disclosure Statement

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Telehealth Delivery of Outpatient Pediatric Surgical Care in Hawai'i: An Opportunity Analysis

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Abstract

In the state of Hawai'i, nearly all pediatric surgical care is delivered on the main island of O'ahu at the state's primary tertiary children's hospital. Outpatient clinic visits require patients and families to travel to O'ahu. The direct and opportunity costs of this can be significant. The objective of this study was to characterize potential telehealth candidates to estimate the opportunity for telehealth delivery of outpatient pediatric surgical care. A retrospective chart review including all patients transported from neighbor islands for outpatient consultation with a pediatric surgeon on O'ahu over a 4-year period was performed. Each patient visit was examined to determine if the visit was eligible for telehealth services using stringent criteria. Direct, insurance-based costs of the travel necessary were then determined. Demographic data was used to characterize the patients potentially affected. A total of 1081 neighbor island patients were seen in the pediatric surgery clinic over 4 years. Thirty-one percent of these patients met criteria as candidates for telehealth visits. The majority of patients came from Hawai'i and Maui. Most patients were identified as Native Hawaiian or Asian. The average cost per trip was \$112.53 per person, leading to a potential direct cost savings of \$37,697 over 4 years. Over 30% of outpatient pediatric surgical encounters met stringent criteria as candidates for telehealth delivery of care. Given the significant number of patients that met our criteria, we believe there is an opportunity for direct, travel-based cost savings with the implementation of telehealth delivery of outpatient pediatric surgical care in Hawai'i.

Keywords

Telehealth, Pediatric Surgery, Hawai'i, Telemedicine, Telecare

Abbreviations

HMSA = Hawaii Medical Service Association
IRB = Institutional Review Board

Introduction

The unique geography of the Hawaiian Islands presents several challenges in terms of access to healthcare. All neighbor islands are considered rural and there are notable disparities in the health care that is available, depending on the island.¹ Furthermore, the Native Hawaiian and Pacific Islander populations represent higher percentages of the local population on the islands of Maui and Hawai'i compared to O'ahu, compounding the access to care issues for these traditionally underserved groups.² Currently, there are no pediatric surgical providers on islands other than O'ahu. The majority of pediatric specialists practice at the state's primary tertiary children's hospital on O'ahu. The general pediatric surgeons do not travel to the neighbor islands

to see patients and all surgeries are completed on O'ahu. Outpatient clinic visits to specialists, therefore, require patients and a respective parent or legal guardian to travel to O'ahu, which could amount to a full day of travel for a relatively quick clinic visit. The cost of this travel (ie, airfare, car transportation, opportunity costs, etc) can be significant. Opportunity costs include those unseen costs such as missed days of school for the child and lost wages from missing work for their legal guardian. Telehealth delivery of outpatient pediatric surgical care has the potential to provide cost effective and convenient care to populations that have traditionally had limited access.

Over the last 5 years, there has been a statewide initiative to develop telehealth programs in Hawai'i. To date, the body of literature surrounding the efficacy of telehealth delivery of pediatric surgical care has been limited. One group found that less than 15% of telehealth consultation were in pediatrics.³ Early studies have demonstrated cost benefits in pediatric burn medicine, pediatric urology, and child psychiatry.⁴⁻⁶ Studies in Canada have shown that telehealth is acceptable with good patient and family satisfaction for cases such as hernias, gastroesophageal reflux disease, soft tissue masses, skin lesions, gastrostomy care, constipation, and other pre-surgery work-up visits and post-operative care visits.⁷⁻⁹ While the results of these studies are promising, it is unclear whether these findings can be extrapolated to the unique population and geographic constraints of Hawai'i.

The objective of this study was to identify the number of patients coming from another Hawaiian island to O'ahu for an outpatient visit. Clinical criteria were then applied to identify the subset of patients who may be managed via telehealth. Cost data provided by Hawaii Medical Service Association (HMSA), Hawai'i's predominant medical insurance provider, was used to calculate potential savings to the Hawai'i health system that can be realized through a telehealth pediatric surgery outpatient clinic.

Methods

This study was a retrospective chart review that analyzed all patients that were transferred from other Hawaiian islands for consultation with a pediatric surgeon over a 4-year period from September 1, 2013–August 31, 2017. All patients who traveled from a neighbor island to O'ahu and were seen in the pediatric

surgery clinic by 1 of 3 board certified general pediatric surgeons at the state's primary children's hospital were included in the study. Demographic data was used to characterize the origin island of the patient as well as the child's ethnic makeup. The reason for the outpatient visit as well as the primary patient diagnoses were also recorded. Clinical elements of each patient visit were then examined to determine if that visit could have been conducted via telehealth. Inpatient admission after the visit, need for surgery or any invasive procedures within 24 hours, need for additional subspecialty consultations or examinations, and need for emergency room evaluation within 30 days of seeing the surgeon for that same problem disqualified encounters as potential telehealth visits. HMSA administrative cost data was then used to determine the potential cost savings via telehealth versus traveling to O'ahu. HMSA was able to provide the cost of the flight from the neighbor islands to O'ahu. This cost was then multiplied by the number of telehealth candidates to estimate cost savings. The study protocol was approved by the Hawai'i Pacific Health Research Institute Institutional Review Board (IRB).

Results

There were 1081 patients seen in the pediatric surgery clinic from other Hawaiian islands over the 4-year period. Seven visits were excluded from the study for the following reasons: the patient lived on O'ahu at the time of the visit, the visit was already a telehealth visit (n=2), the visit was outside of the date range, or because the visits were procedural and were seen by another provider other than the 3 pediatric surgeons. Of the 1081 patients, 335 (31%) of patients were deemed appropriate candidates for telehealth visits. There were various reasons why patients were deemed inappropriate telehealth candidates; the most common reason was that the patient had a pre-operative visit prior to surgery (Table 1). These patients were categorized based on the author's discretion as to which criteria was the most relevant to the patient's overall care. For example, if a patient was seen by another provider such as the pediatric gastroenterologist or the pediatric urologist, but also required operative intervention for a post-operative complication, they were placed in the "complications requiring surgery" category.

From a demographic standpoint, 45% of patients from the neighbor islands came from the island of Hawai'i, 31% from Maui, 17% from Kaua'i, 5% from Moloka'i, and 2% from Lana'i. The percentage of patients deemed appropriate telehealth candidates were proportional to these numbers, with 44% of telehealth candidates coming from Hawai'i, 29% from Maui, 16% from Kaua'i, 9% from Moloka'i, and 2% from Lana'i (Figure 1). More patients identified as Native Hawaiian compared to any

other ethnic group, 46% of the total population and 47% of the potential telehealth population. The next largest ethnic group identified as Asian, which comprised 29% of the total population and 27% of the potential telehealth population (Table 2).

The most common types of visits were follow-up visits and post-operative visits. It is possible that some of the documented follow-up visits could have been post-operative visits, however, we strictly used the limited referral information provided to categorize the visits. Of the telehealth candidates, 37% of visits were coded as follow-up appointments, 33% were coded as post-operative visits, and 31% were coded as initial encounters. The most common pathologies observed for appropriate telehealth candidates were inguinal hernias, stable medically managed hemangiomas, and pectus excavatum followed by umbilical hernias and gastrostomy tube visits that did not require exchange of the feeding tube.

Utilizing data provided from HMSA, the average cost per round trip from a neighboring island was \$112.53 per patient, leading to a potential cost savings of \$37,697 over 4 years. This cost data included only the cost of plane flights for the patient, not including their family member, and did not include costs for rental car, hotel, opportunity costs, etc.

Exclusion Criteria	Number of Patients (%)
Pre-operative Evaluation	257 (34%)
Feeding Tube Assessment/Exchange	134 (18%)
Burn Wound Care	50 (6.7%)
Wound Care/Small Procedures in Clinic	47 (6.3%)
Referral Required/Saw Another Provider	46 (6.2%)
Anal Dilations (Anal Stricture)	33 (4.4%)
Post-op Complication/Specific Complaint	32 (4.3%)
Physical Therapy/Brace Shop	25 (3.4%)
Hemangioma Work-up/Management	22 (2.9%)
Additional Work-up Needed	21 (2.8%)
Needed Physical Exam	20 (2.7%)
Complex Patient/Visit	18 (2.4%)
Admission/Emergency Room Visit Within 24 hours	15 (2.0%)
Complications Requiring Surgery	11 (1.5%)
Other	9 (1.2%)
Operating Room Within 24 hours	6 (0.8%)
Total	746 (69%)

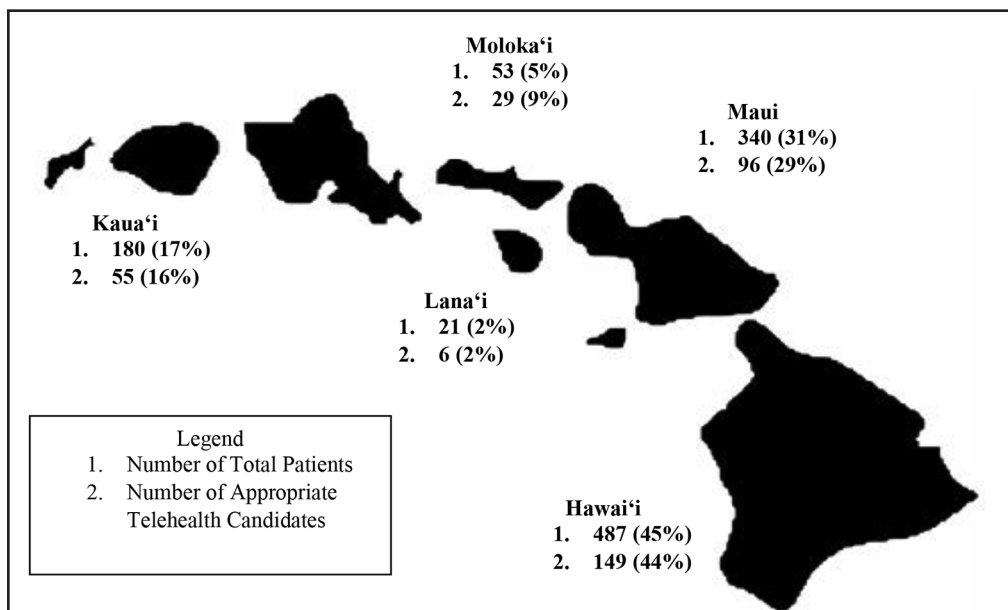


Figure 1. Number and Percentage of Total Patients and Patients Deemed Appropriate Telehealth Candidates by Neighbor Hawaiian Island

Note: The top number is total number of patients from the specific island and bottom number is number of patients deemed appropriate telehealth candidates.

Table 2. Number and Percentage of Total Patients Deemed Appropriate Telehealth Candidates by Race and Ethnicity

Race and Ethnicity	Total Number of Patients (%)	Number of Appropriate Telehealth Candidates (%)
Native Hawaiian	495 (46%)	156 (47%)
African American	6 (0.6%)	3 (0.9%)
American Indian/Alaska Native	15 (1.4%)	7 (2.1%)
Asian	312 (29%)	90 (27%)
Caucasian	187 (17%)	51 (15%)
Hispanic	14 (1.3%)	2 (0.6%)
Other/Unknown	52 (4.8%)	26 (7.8%)

Note: Race and ethnicity were self-reported with the option for other/unknown if the patient did not fit into one category or did not want to report.

Discussion

Multiple studies have shown that telehealth services present several advantages without compromising patient care. A retrospective study in pediatric urology patients compared patients seen post-operatively via telehealth versus an in-office visit. The study found that there were no differences between the groups in terms of post-operative surgical complications. They noted that patients who lived 37 kilometers (23 miles) further away from the hospital were more likely to choose telehealth services than those who lived closer. They ultimately concluded that telehealth could be used post-operatively for both simple and complex surgical cases, resulting in cost savings as well as time savings for both patients and providers.⁴

Additionally, in a recent review of telemedicine for pediatric general surgery post-operative visits, results revealed comparable outcomes between telemedicine and in-person visits. They found a significant decrease in travel cost and time, with no difference in rate of complications.^{10,11} Another study found that implementation of telephone post-operative visits for umbilical hernias and laparoscopic cholecystectomies was not associated with an increase in complication rates. In fact, it led to the opening of 110 new clinic locations.^{10,12} Additionally urology post-operative visits, including radical prostatectomies, have been facilitated via telehealth with improved patient satisfaction and no urologic complications at 3 months.^{10,13} These studies show that telehealth has been successful for both initial visits and post-operative visits, usually in a “hub and spoke” design

with the pediatric surgeon at a tertiary care hospital (hub) and the patient at a remote location (spoke).^{10,14-15}

In Canada, telemedicine services have been utilized in both the adult and pediatric populations with success. An eConsult system has been implemented for adult patients that allows asynchronous consultative provider-to-provider communication, which has improved access to care in the adult population and has high satisfaction ratings by both providers and patients. In a prospective study, this system was applied to the pediatric surgery population in Canada and yielded similar results.¹⁶ The 3 pediatric subspecialties included in the study were general pediatrics, orthopedics, and psychiatry; pediatric surgery was not represented. Responses occurred in 0.9 days on average. The study found almost half (48.4%) of the telemedicine consultations resulted in a change in management of the patient's current plan of care. Additionally, 37% of face-to-face visits were avoided and the time to consult was significantly decreased when compared to a face-to-face visit (1-day vs 132 days; $P < .001$).¹⁶ This study shows that teleconsulting in the pediatric population can increase access to specialists which can change management decisions and prevent unnecessary face-to-face visits. The authors mentioned that this study shows comparable results to the only other pediatric eConsult system (ECHO-Pac) for pediatric asthma patients based out of Tripler Army Medical Center in Hawai'i, which provides medical services to military families.¹⁶

Our cost data likely underestimate the true cost for a patient to travel to O'ahu each visit as it does not take into consideration member copayments and family member travel, which is required for pediatric patients. It is estimated that in Canada the indirect costs of missing work to travel to healthcare appointment adds up to about \$16.6 billion per year.¹⁷ One-third of the families in this study spent at least 4 hours in transit to the appointment and 75% reported that at least one parent missed some amount of work in order to make the appointment.¹⁷ In our study, cost data for transporting a patient from a neighboring island to O'ahu for an outpatient visit was obtained, however, it only included the cost of flight and did not investigate the indirect costs to families and the burden of traveling. It was also specific for HMSA and may be different for other insurance companies. In the future, a prospective study will look at these indirect costs by surveying families who choose traditional in-office visits versus utilization of telehealth services.

For this study in particular, it is important to note that when selecting patients, the authors were very conservative in the criteria used to determine which patients were considered appropriate telehealth candidates. Therefore, it is our belief that this study likely underestimates the actual number of patients who are appropriate candidates for telehealth services. Many pre-operative visits will likely be good telehealth candidates as well, but due to the retrospective nature of this study they were deemed inappropriate telehealth candidates for several

reasons. In many cases, the pre-operative visit was likely to be the only clinical encounter prior to surgery. In this scenario, an in-person visit would be required to complete a thorough physical exam prior to proceeding to the operating room. In more complex cases, it is possible the patient would require referral to other providers or further diagnostic work-up with imaging and labs. Our recently IRB-approved prospective study will enable all patients from the neighbor islands to opt into telehealth services for their visit, including pre-operative visits, so travel to O'ahu would only be necessary for the actual surgery. With some training, we believe that other pathologies can be incorporated, to include some minor burn care, wound care, and gastrostomy tube exchanges. The authors based our analysis strictly on the referral data and information that could be gleaned from the encounters themselves. This indicates that there may be a significant amount of patients that may benefit from telehealth services in Hawai'i that were not necessarily captured in this limited retrospective review.

Furthermore, the study only included completed outpatient visits for patients originating from a Hawaiian island other than O'ahu. This does not include any missed or canceled visits. Given the direct and opportunity costs associated with the required travel, it can be postulated that an even higher number of patients may be candidates for telehealth delivery of outpatient pediatric surgical care. Whether telehealth services would improve the access to care, and thereby the visit completion rate for these patients has yet to be determined. Future studies are planned to evaluate cancellation and "no-show" rates for neighbor island patients versus O'ahu patients as well as for telehealth delivery of care.

Lastly, the demographic results of the study demonstrates a higher percentage of neighbor island patients identify as Native Hawaiian compared to O'ahu based patients.² Native Hawaiians are a traditionally underserved ethnic population with well-established disparities across multiple health care outcomes.¹⁸ By decreasing direct and opportunity costs, telehealth delivery of outpatient pediatric surgical care has the potential to improve access to care for this disproportionately affected population.

In conclusion, use of telehealth services is reasonable in select pediatric surgical patients and offers a significant cost savings to those traveling from other Hawaiian islands. Over 30% of outpatient pediatric surgical encounters met stringent criteria as candidates for telehealth delivery of care. This represents a significant opportunity for direct, travel-based cost savings as well as opportunity cost savings associated with the implementation of telehealth delivery of outpatient pediatric surgical care in Hawai'i. Further research will investigate the impact of telehealth services and examining patient outcomes.

Conflicts of Interest

None of the authors identify any conflicts of interest.

Disclosure Statement

The views expressed in this manuscript are those of the author(s) and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the US Government.

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The NEW Keiki Program Reduces BMI z-scores Among Overweight and Obese Children and BMI Among Their Adult Caregivers in Hawai'i

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Abstract

The high prevalence of childhood obesity highlights the need for effective weight management interventions. This study evaluated a family-based weight management program (Nutrition+Exercise+Weight Management; NEW Keiki) in overweight and obese children and their adult caregivers. Data were collected on overweight (body mass index, BMI = 85th-94th percentile) and obese (BMI > 95th percentile) children (n = 75, 5-14 years) and their adult caregivers (n = 104). Seventy-one percent of the enrolled children identified as Native Hawaiian, Pacific Islander, and/or Filipino (NHPI+F). Families participated weekly in a multidisciplinary lifestyle program for 8-9 weeks (intervention phase); follow-up visits occurred at 6-months and 12-months post-intervention. Long-term data (14-50 months post intervention) were collected by chart review for the children. Change in children's BMI z-score and adult BMI were analyzed. The effects of ethnicity, acceptance of government assistance, and program attendance were evaluated. Participants identifying as NHPI+F and/or receiving government assistance had higher baseline BMI z-scores and BMIs. In children, BMI z-score decreased from baseline at all evaluation visits (-0.05 at 2 months [P < .001], -0.07 at 6-month follow-up [P < .001], -0.04 at 12-month follow-up [P = .05], -0.06 at long-term follow-up [P = .01]). At the 2 month visit BMI decreased from baseline for adults (-0.39 [P < .001]). Decreases in BMI z-score and BMI were independent of program attendance, ethnicity, and acceptance of government assistance. This study, unique in its inclusion of both adults and overweight children, supports the effectiveness of a community-developed program to address weight management in an ethnically diverse population.

Keywords

Obese; Native Hawaiian; Pacific Islander; Filipino; Diverse; Lifestyle changes; Multidisciplinary

Abbreviations

BMI = Body mass index
KMCWC = Kapi'olani Medical Center for Women and Children
NEW = Nutrition+Exercise+Weight Management
NHPI+F = Native Hawaiian, Pacific Islander, and/or Filipino
USPSTF = United States Preventive Services Task Force
YMCA = Young Men's Christian Association

Introduction

Although national family-based weight management programs address pediatric obesity and obesity-related co-morbidities,¹ obesity prevalence for youth 2-19 years old remains high at 18.5% in 2015-2016.² The 2017 United States Preventive Services Task Force (USPSTF) Recommendation Statement concluded that childhood (≥ 6 years) weight management interventions

are beneficial. These interventions should be comprehensive, intensive behavioral interventions with multiple components, including parent and child involvement, goal-setting, self-monitoring, contingent rewards, problem-solving, supervised physical activities, and nutrition information.³ Multidisciplinary programs targeting overweight and obese children are most effective when they involve the whole family.⁴⁻⁶ Consensus and evidence are still forming on specifics and the best structured approach to take, and dependable funding is largely lacking.^{7,8} Engaging families continues to be a challenge for participation in longer-term programs. Currently there is lack of information on the structure and efficacy of weight management programs in high-risk populations and sub-communities.

Pediatric weight maintenance data on long-term outcomes (> 2 years), critical for confirming treatment effect, are lacking,⁹ especially for underrepresented ethnic minorities and lower socioeconomic populations, who are at higher-risk for chronic diseases like obesity.^{1,10-13} Hawai'i has a diverse, multiethnic community with high rates of youth overweight and obesity. In 2005, 26.2% of sixth, seventh, and eighth graders were reported as overweight or obese.¹⁴ In 2015, 28.3% of high school students were reported as overweight or obese.¹⁴ Long-term community-based studies can contribute insight in these populations.¹¹

In 2013, the Nutrition+Exercise+Weight Management (NEW) Keiki Program (*keiki* means "children" in the Hawaiian language) was initiated with Kapi'olani Medical Center for Women and Children (KMCWC) in Honolulu, Hawai'i and the Young Men's Christian Association (YMCA) of Honolulu to address the local pediatric overweight and obesity epidemic and lack of effective programs available to families in Hawai'i. NEW Keiki was premised on the USPSTF recommendations of family inter-dependence and shared obesogenic environment theories, hypothesizing associations between child and parent outcomes and success.¹⁵⁻¹⁷

A core team composed of a pediatrician, registered dietician, fitness trainer, and YMCA program director was assembled to develop an evidence-based program and remained intact throughout its 5-year lifespan. Funding for the program was provided by community partners and grants. Weight management programs validated in other populations were considered but not used due to cost and availability. The team created an original curriculum tailored to local needs and cultural norms.

This study evaluated NEW Keiki for change in children's body mass index (BMI) z-scores, not specific for ethnicity. BMI z-scores measure the number of standard deviations from the reference median BMI and allows comparisons across different age and gender groups. This study also examined adult caregivers' BMI and sustained treatment effect at follow-up.

Methods

NEW Keiki Design

NEW Keiki was a multidisciplinary, family-based program to treat childhood overweight and obesity and related comorbidities by changing family habits. Educational sessions were held weekly in evenings to maximize family participation by minimizing conflicts with work and school schedules. These sessions were held at strategic locations in community locations (YMCA Nu'uanu and Waipahu branches, KMCWC, Pali Momi Medical Center, and Adventist Health Castle) to ease transportation burden. Families were grouped into cohorts that were run consecutively due to team capacity. The first cohort started on April 17, 2013.

The intervention phase consisted of 2-month curriculum on nutrition, home environment, fitness, screen time, medical comorbidities, mental health, and family support. Sessions were led by a multidisciplinary team: pediatrician, registered dietitian, fitness trainer, chef, and program facilitator. The facilitator organized referred families and program staff and oversaw the logistics of all individual sessions, follow-ups and extracurricular activities. The facilitator and program volunteers called and texted families between sessions and after the intervention phase to maintain contact and nurture family engagement.

Each session began with families exercising together. Core content was directed at caregivers while children continued exercising with the trainer. Families were reunited at the end of class to summarize objectives with an activity followed by goal-setting. The dietitian focused nutrition classes on elimination of artificial ingredients, portion control, mindful eating, and healthy eating environments. Screen time limitations and fitness were addressed in sessions taught by the program facilitator and fitness trainer. The pediatrician led discussions on obesity-related co-morbidities as well as behavioral health topics including body image, motivation and stages of change, communication and support within families, and connection of emotional and physical health. A chef conducted cooking classes to teach basic knife skills and food preparation and supervised families creating and eating meals together.

The maintenance phase consisted of follow-up sessions at 6- and 12-months post-intervention (at 8-9 and 14-15 months, respectively, from start date). At follow-up sessions, the pediatrician and registered dietitian met with families individually to review previously set goals, evaluate progress, answer

questions, address challenges, and provide encouragement. The fitness trainer conducted fitness testing on index children and the facilitator collected anthropometric data and lifestyle surveys. Optional monthly extracurricular activities available during the maintenance phase (ie, hikes and farmer's market tours) encouraged family engagement and troubleshooting of ongoing challenges.

In the long-term follow-up phase, data were collected (as available) for the referred child from their medical record. Data were collected up to 52 months from the child's start date in the program. Long-term data were collected through August 31, 2017 and follow-up time ranged from 14-50 months from the end of the intervention.

Study Participants

Community pediatricians on O'ahu were asked to refer motivated pediatric patients (ages 7-12 years) and their families to NEW Keiki. For this research, families were included if the referred child (index subject) was overweight (BMI 85th-94th percentile) or obese (BMI \geq 95th percentile) and had at least 1 participating parent/adult caregiver. Child age was not an exclusion criteria. Families who could not provide informed consent in English were excluded.

The study was reviewed and approved by the Western Institutional Review Board (20140337). Parents/caregivers provided informed consent and children 6-17 years old provided assent. Family units were consented together, and included other siblings and non-nuclear family members who wanted to participate and who provided consent and assent as appropriate. Consent to participate in the research was not required for participation in NEW Keiki. Data reported are only from families that agreed to participate in the research.

Data Collection

Data were collected at up to 5 time points (Figure 1): start of the intervention (Visit 1), immediate post-intervention (Visit 2), 6-months post-intervention (Visit 3), 12-months post-intervention (Visit 4), and 14-50 months post-intervention (Visit 5; by chart review only). Height, weight, BMI, blood pressure and heart rate were taken on-site with participants in bare feet and light clothing by program volunteers using calibrated equipment, scales, and stadiometers.

Families were asked to complete written questionnaires at each visit to collect demographics, attitudes, health habits, and socioeconomic status. Questions were based on previously validated instruments.^{18,19} Some questions were altered to reflect local norms.

Trainers completed fitness evaluations on index children to assess cardiovascular health, flexibility, and balance. The refer-

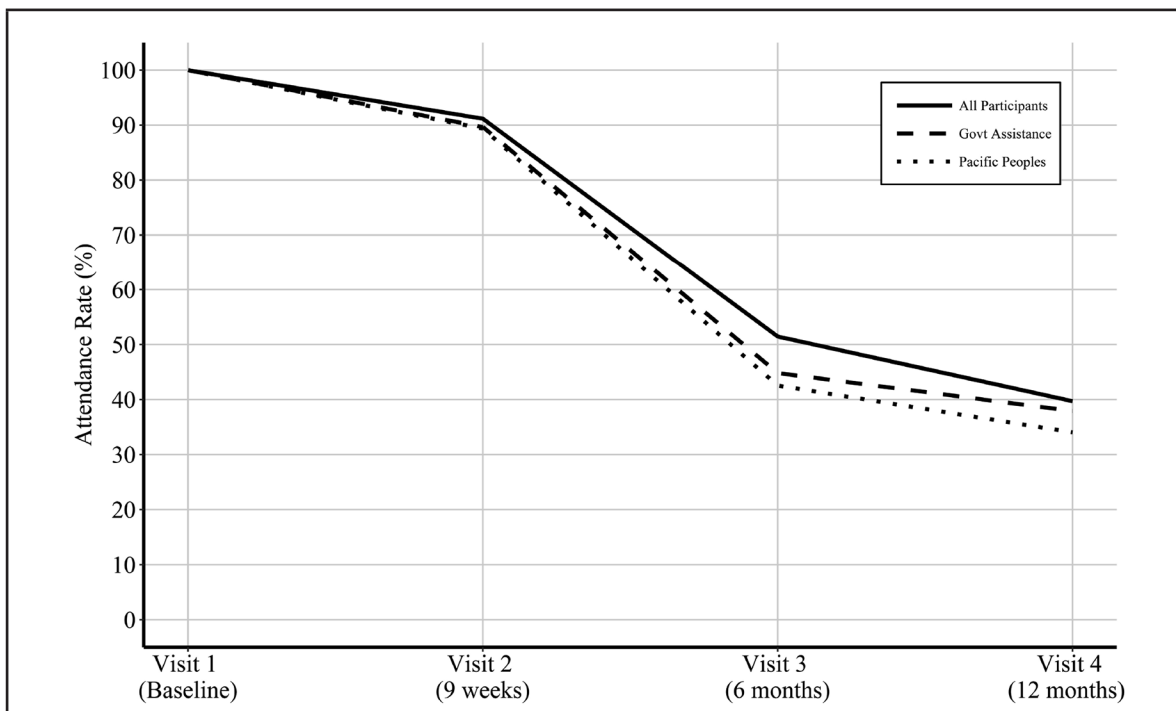
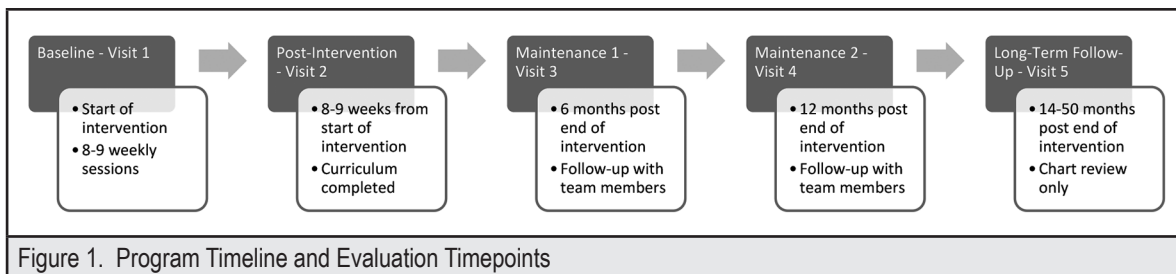


Figure 2. Program Attendance of Families, by Acceptance of Government Assistance and Ethnicity, at Formal Visits Immediately Post-intervention (Visit 2), 6 Months (Visit 3) and 12 Months (Visit 4) Post-intervention

ring pediatrician obtained fasting laboratory screenings for comorbidities such as hyperlipidemia, diabetes, and non-alcoholic liver disease within 1 year of enrollment in NEW Keiki.

Each family was asked about program satisfaction during an in-person, post-participation interview at Visit 4. Volunteers who did not administer the interventions interviewed participants to encourage honest and open responses. Families who did not attend Visit 4 had phone interviews and were considered lost to follow-up if not reached after 3 attempts.

After Visit 4 for the final cohort, follow-up anthropometric data were collated on index children from their medical record (Visit 5). Anthropometric and lab data were reported if documented from a well check or obesity-focused visit. If multiple visits were eligible, Visit 5 was the furthestmost from end of the child's intervention.

Statistical Analysis

Exploratory analyses were conducted for participation, demographic, and clinical data using descriptive statistics. To examine changes in BMI z-scores (children) and BMI scores (adults), Singed rank test was utilized. Ethnicity or government assistance effects on BMI z-score or BMI score were examined using the Mann-Whitney test. Bivariate associations between attendance and ethnic group or family financial status were determined with Chi-squared or Fisher's exact test. Relationships between BMI z-score change (in children) and BMI change (in adults) were evaluated using Pearson correlation coefficient. A *P*-value of $< .05$ was considered significant. R Version 3.4.3 (R Development Core Team: Vienna, Austria) was used for the analyses.

Results

Participants

A total of 77 families comprised of 267 participants (including 87 physician-referred children) enrolled in 12 cohorts (April 17, 2013-May 31, 2017). Cohorts of 4-8 families (averaging 6.4 families per cohort) attended weekly sessions during the intervention phase. As the curriculum evolved, the first 3 cohorts attended 8 sessions over 8 weeks, and the remaining 9 cohorts attended 9 sessions over 9 weeks. Assuming perfect attendance, total contact hours per enrolled family equaled 26.5 hours over the 14-month program (this includes activities during the maintenance phase).

Seventy-five children (86%) from 68 families consented to participate in the research study. One hundred thirty-five adults enrolled in NEW Keiki — most were parents, but the group also included grandparents, aunts, and uncles. Of these, 104 (77%) consented, including 61 (59%) who were mothers of index subject. Beyond the index child and adult caregivers, 34 family members (siblings and cousins < 18 years) were included in the program to encourage family participation but were not included in the results.

Table 1 shows the characteristics of the index children. Native Hawaiian, Pacific Islander, and/or Filipino (NHPI+F) represented the majority of participants (71%). Half of the families reported accepting government assistance from various programs.

Program Attendance and Retention

Of 68 families, 62 (91%) completed intervention phase, however, only 22 of 68 families (32%) attended both Visits 3 and 4 (Figure 2). Eighteen families (27%) attended either Visit 3 or 4, and 28 families (41%) attended neither, including 6 families (9%) who dropped out.

Forty-seven families (69%) identified as NHPI+F. Intervention completion was 42 of 47 (89%) for NHPI+F and 20 of 21 (95%) non-NHPI+F families. Attendance at Visits 3 and 4 were 23% for NHPI+F families and 52% for non-NHPI+F families ($P=.03$).

Among families accepting government assistance, 26 of 30 (87%) completed the intervention phase as compared to 28 of 30 (93%) who did not accept government assistance ($P=.44$). Attendance at Visits 3 and 4 were 31% for families accepting assistance and 42% for families who did not accept assistance ($P=.38$).

Anthropometric data collected during Visit 5 was available for 49 of 75 (65%) children.

Table 1. Baseline (Visit 1) Characteristics of Index Children	
	median (min, max)
Anthropometrics (n=74*)	
BMI, kg/m ²	29.02 (21.04, 51.82)
BMI z-score	2.37 (1.42, 3.01)
Weight, kg	63.75 (30.80, 154.90)
Height, cm	146 (121, 173)
Demographics (n=75*)	
n (%)	
Age, y	10 (5, 14)
Gender	
Male	38 (51%)
Female	37 (49%)
School Type	
Public	62 (85%)
Private	11 (15%)
No response	3 (4%)
Ethnic Group	
Native Hawaiian	26 (35%)
Native Hawaiian and/or Pacific Islander	39 (52%)
Native Hawaiian, Pacific Islander, and/or Filipino	53 (71%)
Accepting Government Assistance (n=64*)	
SNAP	15 (23%)
Free/reduced School Lunch	23 (36%)
WIC	11 (17%)
Medicaid	28 (44%)
"Yes" to at least one of the above choices	32 (50%)
Laboratory Values (n=68*)	
Cholesterol, mg/dL	
Total ≥ 170	23 (34%)
HDL < 40	23 (34%)
LDL ≥ 100	21 (31%)
HbA1c ≥ 5.7 (n=59*)	23 (39%)
ALT ≥ 30 (n=58*)	12 (21%)

Data are presented as median (range) unless otherwise indicated. HDL indicates high-density lipoprotein; LDL indicates low-density lipoprotein; HbA1c indicates Hemoglobin A1c; ALT indicates alanine aminotransferase. *Variations in n were due to (1) baseline anthropometric data not captured in one child, (2) some participants choosing not to answer demographic questions, and (3) laboratory values not collected by pediatricians.

BMI z-score and BMI

BMI z-scores for children progressively decreased from baseline (Visit 1) at all evaluation visits. This decrease in BMI z-score was statistically significant at Visits 2, 3, and 5 (Table 2). BMI for adults decreased progressively from baseline at Visits 2, 3, and 4, achieving statistical significance only at Visit 2.

The median baseline BMI z-score was 2.37. The median baseline BMI z-score was higher in NHPI+F children (2.40) than non-NHPI+F children (2.20; $P=.02$) and in those accepting government assistance (2.49) versus those who did not (2.27; $P=.01$). Median baseline BMI of adults was 31.77 and was higher in NHPI+F adults (34.26) than non-NHPI+F adults (27.1; $P<.001$) and between those accepting assistance (33.17) and those who did not (30.86; $P=.04$).

The correlation coefficient between a child's BMI z-score change and their adult caregiver's BMI change were small ($\rho=.04$ from Visit 1 to Visit 2; $\rho=.04$ from Visit 1 to Visit 3; $\rho=.01$ from Visit 1 to Visit 4) and not significant.

Post-Participation Findings

At Visit 4 families were asked to complete a questionnaire about their experience in NEW Keiki. The majority of families completed the survey ($n=41$, 60%). Most families reported continuing at least 50% of lifestyle changes made during the program (88%), 61% reported family participation in at least one extracurricular activity outside of the weekly intervention classes, and 80% followed-up with their pediatrician (Table 3). Moreover, families were satisfied with the program (95%) and felt that it met their expectations and needs (90%) in a culturally sensitive manner (88%).

Table 2. BMI and BMI z-score Changes Compared to Baseline Visit 1 of Study Focus Participants										
	Visit 1 BMI z-score	P	Change at Visit 2	P	Change at Visit 3	P	Change at Visit 4	P	Change at Visit 5	P
All Children	2.37 (1.42, 3.01)	—	-0.05 (-0.13, -0.01)	<.001	-0.07 (-0.20, -0.02)	<.001	-0.04 (-0.17, 0.02)	.05	-0.06 (-0.23, 0.05)	.01
NHPI+F children	2.40 (2.22, 2.70)	.02	-0.04 (-0.09, -0.01)	.17	-0.06 (-0.11, -0.01)	.05	-0.04 (-0.16, 0.02)	.91	-0.05 (-0.17, 0.05)	.42
Non-NHPI+F children	2.20 (1.96, 2.44)		-0.09 (-0.16, -0.02)		-0.11 (-0.23, -0.06)		-0.04 (-0.20, 0.02)		-0.11 (-0.31, 0.04)	
Children in families accepting government assistance	2.49 (2.17, 2.76)	.01	-0.06 (-0.13, -0.01)	.92	-0.07 (-0.18, -0.02)	.99	-0.05 (-0.20, -0.01)	.33	-0.06 (-0.16, 0.05)	.52
Children in families not accepting government assistance	2.27 (1.94, 2.40)		-0.04 (-0.11, -0.01)		-0.07 (-0.18, -0.02)		-0.04 (-0.08, 0.06)		-0.09 (-0.28, 0.05)	
	Visit 1 BMI									
All Adults	31.77 (20.34, 73.62)	—	-0.39 (-0.93, -0.04)	<.001	-0.18 (-0.59, 0.45)	.42	-0.02 (-1.51, 0.48)	.45		
Adults with NHPI+F Children	34.26 (30.29, 41.03)	<.001	-0.39 (-0.93, -0.04)	.72	-0.05 (-0.50, 0.51)	.30	-0.02 (-2.11, 0.54)	.74		
Adults with Non-NHPI+F Children	27.1 (24.91, 31.36)		-0.38 (-0.94, -0.05)		-0.28 (-0.62, 0.15)		-0.02 (-1.06, 0.43)			
Adults in families accepting government assistance	33.17 (30.20, 41.11)	.04	-0.37 (-0.66, -0.04)	.24	-0.19 (-0.40, 0.19)	.81	-0.36 (-1.17, 0.46)	.76		
Adults in families not accepting government assistance	30.86 (26.06, 35.45)		-0.5 (-1.06, -0.16)		-0.18 (-0.68, 0.50)		-0.02 (-1.96, 0.43)			

Data are presented as median (IQR) unless otherwise indicated. NHPI+F indicates Native Hawaiian, Pacific Islander and/or Filipino. P-values for All Children and All Adults compare BMI z-score and BMI between visits. All other P-values compare between groups (NHPI+F vs non-NHPI+F and government assistance vs non-government assistance).

Table 3. Program Satisfaction Post-Participation Survey Results Conducted at Visit 4 n=41 (Response rate 60%)	
Has your family been able to maintain any lifestyle changes made during the program over the last 12 months?	
Yes, about 100% of lifestyle changes	1 (2%)
Yes, about 75% of lifestyle changes	13 (32%)
Yes, about 50% of lifestyle changes	22 (54%)
Yes, about 25% of lifestyle changes	3 (7%)
No, we did not maintain any lifestyle changes	2 (5%)
Did the program meet your family's expectations and/or needs?	
Strongly Agree	25 (61%)
Agree	12 (29%)
Neutral	3 (7%)
Disagree	1 (2%)
Completely Disagree	0 (0%)
Were the class visits:	
Just the right frequency	35 (85%)
Too frequent	1 (2%)
Not frequent enough	3 (7%)
No response	2 (5%)
Did your family bond or make a personal connection with at least one program team member?	
Yes	32 (78%)
No	8 (20%)
No response	1 (2%)
How did the following items make it harder to attend classes, follow-ups and complete the program?	
Participation Fees/Program Cost	41 (100%)
Program Schedule	12 (29%)
Program Location Site(s)	3 (7%)
Transportation	1 (2%)
Childcare or Eldercare	3 (7%)
Concerns about missed school or work	9 (22%)
Family readiness to make changes	7 (17%)
How satisfied was your family with the program?	
Completely satisfied	27 (66%)
Very satisfied	6 (15%)
Satisfied	6 (15%)
Slightly satisfied	2 (5%)
Not at all satisfied	0 (0)
Did your family feel classes and teachings on lifestyle habits were culturally sensitive?	
Strongly Agree	22 (54%)
Agree	14 (34%)
Neutral	2 (5%)
Disagree	1 (2%)
Completely Disagree	2 (5%)

How many extracurricular activities (optional hikes, tours, other activities) did your family participate in since starting the program?	
More than 5 activities	3 (7%)
3-5 activities	7 (17%)
1-3 activities	15 (37%)
None	16 (39%)
Did your family have follow-up in the past 12 months from the primary care doctors who referred you to the program specifically related to lifestyle changes, weight management?	
Yes	33 (80%)
No	7 (17%)
No Response	1 (2%)

Discussion

The results of this study support the effectiveness of a multi-disciplinary, intensive intervention for pediatric overweight and obesity management. This community-based program, developed according to USPSTF recommendations, met community needs and provided additional evidence that these types of programs can be effective at sustained reduction in BMI z-scores in high-risk, ethnically-diverse populations.^{13,20} Ethnic minorities and economically-disadvantaged families are historically underrepresented in pediatric overweight and obesity studies.^{3,4,9} Furthermore, the high attendance rate, particularly during the intervention portion of the program, demonstrated the ability of this type of program to engage community members.

The primary outcome of this study was change in child BMI z-score. Previous studies suggested that decreases in BMI z-scores of at least 0.125 were needed to change cardiometabolic risk factors, however, a specific value had not been established.²¹ Although the children in this study showed modest BMI z-score reductions (-0.05 at Visit 2, $P < .001$), these reductions were sustained up to 4 years post-participation in the program (-0.06 at Visit 5, $P = .01$). BMI z-score is one way to quantify the benefit of a weight management program, however, participants may benefit in other ways from participation in a program like NEW Keiki.

Sustained lifestyle change is necessary to improve long term health outcomes. NEW Keiki promoted maintaining lifestyle changes by (1) linking contingent rewards to personal and program milestone achievements, (2) hosting group extracurricular events, and (3) encouraging peer and team support of lifestyle goals through calls and texts. Family-based interventions tend to have short term effects,²² however, children in this study were able to maintain BMI z-score reductions. Interestingly, this reduction was independent of family participation in follow-up visits. There were no differences in BMI z-score reductions between families that attended all follow-up visits and those who did not, supporting the findings of Savoye et al that “leaving the families to their own devices” fosters a sus-

tained treatment effect.¹³ Selection bias may have contributed to the ability of families to sustain weight reduction without continued intervention because enrolled families may have been more self-reliant and motivated than families who were referred to the program, but did not enroll.

It is widely accepted that parental obesity is a strong risk factor for childhood obesity, including persistence into adulthood.^{2,3} The lack of correlation within families between reduction in adult BMI and child BMI z-scores suggests complex interactions exist between weight management and lifestyle programs. For example, family members may be at different stages of readiness and motivation for change. With a larger sample size, correlations may have been identified.

Retention is also important for ensuring that participants learn skills for long-term change. The retention rate for NEW Keiki during the initial intervention (91%) was significantly higher than other reported programs.²³⁻²⁵ As a community-developed program, NEW Keiki had the flexibility to adjust to meet participant needs. For example, Cohort 1 included a cooking class and farmer's market tour; all subsequent cohorts replaced the tour with a second cooking class. A third nutrition class was added beginning with Cohort 4 to allow for expansion on topics most interesting to families. Initially, a psychiatrist facilitated the behavioral health discussions, however, the NEW Keiki pediatrician assumed this responsibility by Cohort 4 because families felt more comfortable with familiar team members. A program enrollment fee was instituted starting with Cohort 5 to improve retention and engage families. This fee was refunded incrementally as an incentive. While parents' attitudes about weight management program incentives differ,²⁶ the goal was to improve retention through USPSTF-endorsed contingent rewards.³ The enrollment fee decreased in later cohorts based on the feedback received from participants. Additionally, the fee was waived or reduced if families felt the fee was a barrier to enrollment. Although all surveyed families felt that program cost was a barrier to participation (Table 3), they were amenable to a small participation fee. Families recognized the program's value, and willingness to pay a small fee could support financial sustainability for future pediatric weight management programs.

Although participation rates were high during the weekly intervention portion of the program, nearly half of families did not attend any formal follow-ups (Visits 3 and 4). Because maintaining lifestyle change is lifelong, future family programs must have resources to continue follow-up indefinitely.¹⁹ The existing relationship with medical systems allowed for collection of long-term follow-up data on index children by chart review. This is a benefit of integrating a community-based program within the health care system.

The lack of control group and small sample size limited the interpretation of treatment effect. Additional variability was introduced through program changes and use of on-site measurement tools. The relatively small sample size may have been insufficient to fully elucidate the influence of ethnicity and financial status on crucial components of program success. In the current analysis, ethnicity and acceptance of government assistance negatively impacted program retention but not BMI z-score or BMI outcomes. Factors that can influence retention and follow-up rates in high-risk populations include program schedule, work and school disruptions, readiness, and socioeconomic supports necessary for change.^{25,29} Other environmental, socioeconomic, and cultural aspects were not analyzed and may also contribute to outcomes.^{27,28} In a 2011 Cochrane obesity review, treatment effect can be skewed if families have positive experiences or are confident in their success and thus likely to follow-up; whereas, those more challenged or less confident do not follow-up.³⁰

NEW Keiki was unique with its inclusion of adult parents and caregivers and overweight children. To the authors' knowledge, this is the first pediatric weight management program that reported measured (not self-reported) adult BMI outcome.³¹ It was encouraging that although NEW Keiki was pediatrics-based, adults also benefitted with decreased BMI. Adult caregiver engagement is crucial to children's success as they depend on family units, particularly parents, to maintain lifestyle changes.^{3,4,24} There are limited data and no USPSTF recommendations regarding management of overweight children. NEW Keiki showed that overweight and obese children equally benefit from weight management and healthy living programs. This study suggests that a community-based weight management curriculum is effective in multiethnic communities and those accepting government assistance. NEW Keiki participants achieved long-term weight management success and can serve as a model for future community-based programs.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Benefits of Oral Health Education at Women, Infant, and Children (WIC) Clinic Visits: Assessments of Parent's Oral Health Beliefs, Behaviors and Dental Access in O'ahu, Hawai'i

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Abstract

Improving oral health outcomes in Hawai'i for children and families remains a high priority. Children in the state are leading the nation with the highest caries rates, while women before, during, and after pregnancy are failing to receive regular and necessary dental care resulting in poor health outcomes. To answer for this need, an educational intervention was conducted among families enrolled in the Kapi'olani Medical Center for Women and Children's Women, Infant, and Children program (WIC) in O'ahu. The project included the following activities: (1) identification the oral health beliefs and behaviors of families, (2) providing oral health education to families, and (3) reassessing beliefs and behaviors in 3-6 months to document the impact of the education session. Participants consisted of 81 families resulting in the data on 176 children and 4 pregnant women. Of the 81 families, 40 representing 84 children completed the follow-up oral health questionnaire. Results of the assessment and education demonstrated a positive impact on the family's oral health behaviors. Parents were 6.61 times as likely to report using fluoride toothpaste in the follow-up visit compared to their initial visit (95% confidence interval [CI]=3.12-14.00). Additionally, statistically significant changes were noted in the frequency of children's daily tooth brushing (odds ratio [OR]=2.15, 95% CI=1.33-3.46), as well as in the incidence of children receiving fluoride varnish application over time (OR=2.66, 95% CI=1.50-4.73). These results provide further evidence that initiating a simple educational intervention can have a positive impact on oral health behaviors in groups that are at highest risk for developing dental disease in Hawai'i.

Keywords

Children, Hawai'i, Oral health, Pregnant women, WIC Clinic

Abbreviations

CI = Confidence interval

KMCWC = Kapi'olani Medical Center for Women and Children

OR = Odds ratio

Q = Question

WIC = Women, Infant and Children program

Introduction

The State of Hawai'i faces oral health challenges due to its geographical location, cultural diversity, high cost of living, lack of a dental schools, limited dental benefits for adults with MedQuest (Medicaid) insurance and no current statewide fluoridation system, except on military bases.¹ These challenges have led to negative outcomes: 1) less than acceptable rates of women accessing recommended dental care prior to, during, and after their pregnancy and 2) caries rates for children that are more than double those documented in children residing in the contiguous United States (US),³ resulting in a grade of "F"

in consecutive oral health report cards published by The Pew Center on the States.^{4,5}

The Hawai'i Oral Health: Key Finding Report (2015) indicated that there are substantial dental health disparities in Hawai'i, with low income populations having higher rates of dental problems while having less frequent dental visits.¹ The 2016 Hawai'i Smiles report, based on oral health surveillance of third graders, revealed that more than 7 out of 10 third graders (71%) experienced tooth decay, and oral health disparities for children were noted based on income, race/ethnicity and geography.³

Maintaining and improving oral health is particularly important during pregnancy because of the potential perinatal complications (eg, prematurity, low birth weight infants, pre-eclampsia) associated with dental disease in pregnant women,^{6,7} and the possible transmission of cariogenic bacteria to their infants.⁸ Despite documentation of the importance of dental visits before and during pregnancy, and the safety and efficacy of dental care at all stages of pregnancy, most pregnant women in Hawai'i do not see a dentist.² During 2009-2011, only 41% of pregnant women in Hawai'i reported seeing a dentist during their pregnancy.²

Increasing preventive oral health services by non-dental health care providers is one of the strategies suggested by the Hawai'i State Department of Health's Family Health Services Division. The implementation of preventive oral health programs in primary care practices in other states has been documented to be an effective way to change parents' oral health beliefs and behaviors and provide preventive treatments for children (eg, application of fluoride varnish).⁹⁻¹⁰

Despite the numerous articles acknowledging the benefits of water fluoridation for the prevention of caries, fluoride remains a topic of controversy in Hawai'i. However, to date, there has been limited information investigating the public's current knowledge about fluoride and family's acceptance of fluoridation if they knew it could benefit their child's oral and systemic health. The introduction of oral health education as part of WIC clinic services is not a new idea and has been implemented in WIC clinics throughout the US.¹¹⁻¹⁴ Positive outcomes that have been associated with oral health education including changes in clients' oral health beliefs and behaviors, increased rates of accessing preventive dental services, and a reduction of early childhood caries.¹¹⁻¹⁴

The proposal for the oral health initiative for the Kapi‘olani Medical Center for Women and Children (KMCWC) WIC Clinic was based upon the best practices documented in the literature.¹¹⁻¹⁵ In addition, results from a recent oral health pilot project conducted at the Kona WIC Clinic on Hawai‘i island revealed that providing information to parents about current recommendations for caries prevention was welcomed by clients.¹⁵ The analysis of the data collected at the Kona WIC Clinic resulted in several key findings about the oral health practices of families and health care providers in the region. Parental knowledge about fluoride was limited, with almost half stating they had no knowledge. In addition, despite the state’s lack of community fluoridation for the majority of the population, there was a low percentage of infants and children > 6 months of age, receiving fluoride prescriptions (40%) and equally low percent who had received fluoride varnish (42%).¹⁵

As the result of the Kona WIC project findings, the KMCWC WIC oral health project was proposed to further evaluate this simple intervention. The Kona WIC pilot project involved a single questionnaire and educational session without any subsequent encounters with the clients to determine retention of knowledge about oral health and clients’ successes and challenges accessing dental care. To obtain this information, the KMCWC WIC Clinic Project added a 3-6-month follow-up visit so that clients participating in the project could complete a follow-up questionnaire to assess whether there were any behavior changes and access to dental services following the initial oral health education.

Methodology

The oral health project at KMCWC WIC Clinic, consistent with the Kona WIC project, was developed to be a simple and sustainable solution to address the prevention of dental disease in pregnant women and young children (ie, children 5 years of age and younger). WIC Clinic are an excellent environment for providing oral health messaging for several reasons: 1) pregnant women and mothers with children under age 5 years have regular WIC visits; 2) maternal and child nutrition, which can affect oral health outcomes, is discussed at each WIC visit; and 3) WIC Clinic staff are known and trusted by the families as a valuable source of information about available services in their community. The KMCWC WIC Clinic is located in Honolulu on the island of O‘ahu.

Study criteria for participation included being a KMCWC WIC-enrolled families (ie, parent/guardian of a child or pregnant woman), residing in O‘ahu, and English-speaking. Families were excluded if they could not speak English or were returning to their residence, not located on O‘ahu, within the next 6 months. Oral health questionnaires were used to determine parent’s oral health beliefs and behaviors and included questions pertaining to their current oral hygiene habits, nutrition intake, knowledge and use of fluoridation, and dental access. The questionnaires were developed based on previously published studies, includ-

ing the Kona WIC study as well as feedback from state and national dental experts.¹⁵

There were 2 time points during the project in which data was collected using the oral health questionnaires. The initial visit consisted of parental consent, completion of the initial questionnaire, oral health education and provision of dental supplies (ie, toothbrush, toothpaste, dental floss) to the family. The oral health education included information on nutrition to reduce caries (ie, limit sugar, juices, eliminate bottle use by 14 months), proper dental hygiene (ie, brushing twice a day, floss daily), description of fluoride and proper use (ie, toothpaste, prescription, varnish), and the importance of preventive dental visits every 6 months. Educational brochures were provided to support this short 5-7-minute oral health education session. The follow-up visit took place 3-6 months after the initial visit and consisted of completion of the follow-up questionnaire, additional oral health education based on the participant survey responses, and provision of dental supplies to the family, which reinforces the importance of changing one’s toothbrush every 3 months.

Prior to implementation, the University of Hawai‘i Committee on Human Studies and the Western Institutional Review Board reviewed and accepted the project proposal, satisfying KMCWC requirements for the protection of human subjects for quality improvement or research projects conducted at the Medical Center.

Recruitment

Program recruitment and educational materials were developed based on a review of the literature documenting the best practices about the integration of oral health into WIC Clinics as well as the experiences and the recent results from the WIC Kona Pilot Project.

At the clinic’s main desk, the receptionist invited clients checking in for appointments to participate in the project. Clients willing to participate in the project were provided the appropriate informed consent form (ie, non-pregnant women with children received the child informed consent document and pregnant women received the perinatal informed consent document). After signing the consent form, a member of the research team asked and recorded clients’ responses to questions from the child and perinatal oral health questionnaires.

Once the questionnaires were completed, oral health education was provided for all of the children in a family based on the child’s age and relevant history noted in the questionnaire. Following parent/guardian education, dental kits were distributed and a follow-up WIC appointment was made, allowing for the completion of the follow-up oral health questionnaire, further oral health education and distribution of additional dental kits, and endorsement of the practice of replacing toothbrushes every 3 months.

Statistical Analysis

Descriptive statistics were computed using frequencies, percentages, means, and standard deviations. Parent's response to oral health questionnaire was compared between the 2 time points using McNemar-Bowker's test (a generalized version of McNemar's test for variables with more than 2 categories). Significant questions were treated as binary (Yes vs. No/Other/Uncertain, More than once a day vs. \leq Once a day). For the variables, generalized estimating equations for repeated measures (ie, baseline vs. post-intervention) were performed using logit link and accounting for correlation within family as well as adjusting for the baseline variables of parent's age, marital status, and child's age that presented significant association with at least one of the questions. Odds ratio (OR) and 95% confidence interval (CI) were used to assess the effect of the intervention on the questions. A *P*-value less than .05 was considered statistically significant and all analyses were performed in SAS 9.4 (SAS Institute: Cary, NC).

Results

Initial Visit Analysis

Initial participants included in the study were 81 families that resulted in the collection of data on 176 children and 4 pregnant women. However, due to the small number of pregnant women, the analyses were restricted to the parents with children in this study. Table 1 presents the characteristics of WIC clients who completed the initial questionnaire. The majority of caregivers completing the survey were noted to be the mother of the children (98%) with an average age of 31 years (standard deviation [SD]=6.4). A large percent (69%) of the children enrolled in the KMCWC WIC Clinic were cared for by parents with a high school or less than high school education. The ethnic and racial background of parents, mostly mothers, indicated that the majority of participants were non-Hispanic (93%) and identified as being more than one racial or cultural group. The largest

Table 1. Participant's Characteristics			
Variable	Baseline (n=81)	Follow-up (n=40)	<i>P</i> -value ^a
Relationship with Child, n (%)			
Mother	79 (98%)	40 (100%)	1.0
Father	1 (1%)	0 (0%)	
Other	1 (1%)	0 (0%)	
Age, Mean \pm SD (Range)	31.4 \pm 6.4 (20-49)	29.8 \pm 5.7 (20-44)	.022
Marital Status, n (%)			
Married/Cohabitated	60 (74%)	28 (70%)	.41
Other (Never Married/Separated)	21 (26%)	12 (30%)	
Ethnicity, n (%)			
Non-Hispanic or Latino	75 (93%)	36 (90%)	.43
Hispanic or Latino	6 (7%)	4 (10%)	
Race*, n (%)			
White	17 (21%)	11 (28%)	.155
Asian	42 (52%)	26 (28%)	.019
Chinese	18 (22%)	11 (28%)	.26
Japanese	14 (17%)	9 (23%)	.22
Filipino	17 (21%)	13 (33%)	.015
Other Asian	6 (7%)	2 (5%)	.68
Hawaiian or Other Pacific Islander	43 (53%)	20 (50%)	.58
Native Hawaiian	24 (30%)	16 (40%)	.044
Other Pacific Islander	21 (26%)	6 (15%)	.027
Other Race	4 (5%)	1 (3%)	.62
Highest Level of Education, n (%)			
Less than or Equal to High School	55 (69%)	26 (65%)	.47
Some College or Greater	25 (31%)	14 (35%)	
# of Children per Family, Mean \pm SD (Range)	3.2 \pm 2.1 (1-10)	4.3 \pm 2.3 (2-10)	<.001

* Participants can choose multiple races.

^a To compare participants who did not complete the follow-up questionnaire and who did, Fisher's exact test or Chi-square test for categorical variable and two sample t test for continuous variable was conducted.

percentage of participating mothers came from minority groups that included Native Hawaiian (30%), Other Pacific Islanders (26%), Filipino (21%), Chinese (22%), and Japanese (17%).

Table 2 shows the clients' responses of the oral health questionnaire for initial visit. When responding to the question about when they started cleaning their child's teeth about half (48.9%) responded they started cleaning their child's teeth when the first tooth came in. For the parents who started cleaning their child's teeth, the authors asked if they used fluoride toothpaste to brush their child's teeth (Question [Q] 6). Results indicated that only 57% of parents were using fluoride toothpaste for their children, while 19% reported being unsure if the toothpaste they were using for their child contained fluoride. Additionally, parents were asked to indicate whether their child's pediatrician prescribed fluoride drops or tablets (Q8). The results indicate among children old enough to receive fluoride supplements (ie, >6 months), over one-third were not given a fluoride prescrip-

tion. Among parents given a prescription for their children, almost 70% gave it daily (Q9). Parents were asked if their child ever had fluoride varnish applied to their teeth (Q10). Results indicated that 50 of 151 (33%) of children >6 months old had not received any fluoride varnish application.

Dental access for children on O'ahu was also documented. Of those children who were at the recommended age of 1 year to receive preventive dental care (n=138), 64% were seen by a dentist during the past 3-6 months, 1% reported being seen 1-2 years previously, and 22% reported that their children had not been seen for a dental assessment (Q12). Dental care for mothers during and after pregnancy was also measured (Q15). Results from the initial questionnaire revealed that 66% of mothers did not see a dentist during pregnancy and when asked to recall when they last had a dental evaluation the majority of mothers (65%) did not have routine dental care based on the American Dental Association recommendations.

Table 2. Oral Health Questionnaire at Baseline and Post Intervention			
Variable	Baseline (n=176)	Post Intervention (n=84)	P-value
Q1. What is your child's age in years and months?	3.9 ± 3.5	4.4 ± 3.9	<.001
Mean ± SD (Range) (in years.)	(0-16)	(0.2-17)	
<1	38 (22%)	11 (13%)	
1-4	68 (39%)	36 (43%)	
5-8	49 (28%)	23 (27%)	
>8	21 (12%)	14 (17%)	
Q2. Is your child currently drinking from a bottle or breastfeeding?			.39
No	107 (61%)	59 (70%)	
Yes	68 (39%)	25 (30%)	
Both	1 (1%)	0 (0%)	
Q3. What do you most often put in your child's cup or bottle during the daytime?			.85
Water	114 (65%)	58 (69%)	
Milk	22 (13%)	8 (10%)	
Formula	23 (13%)	8 (10)	
Juice	3 (2%)	1 (1%)	
Other	14 (8%)	9 (11%)	
Q4. Does your child sleep with a cup or bottle (other than water) at nap or bedtime?			.096
No	153 (87%)	78 (93%)	
Yes	23 (13%)	6 (7%)	
Q5. When did you first start cleaning your child's teeth?			.040
When their first tooth came in	86 (48.9%)	66 (79%)	
After one year	51 (29.0%)	8 (10%)	
After two years	8 (5%)	0 (0%)	
Teeth have not been cleaned (skip to Q8)	6 (4%)	2 (2%)	
My child does not have any teeth yet (skip to Q8)	25 (14%)	8 (10%)	

Table 2. Oral Health Questionnaire at Baseline and Post Intervention (Continued)			
Question (Q)	Baseline (n=176)	Post Intervention (n=84)	P-value
Q5 (Restricted to children aged ≥1 year).			
When their first tooth came in	78 (57%)	57 (85%)	.35
After one year	50 (36%)	8 (12%)	
After two years	8 (6%)	0 (0%)	
Teeth have not been cleaned (skip to Q8)	1 (1%)	0 (0%)	
My child does not have any teeth yet (skip to Q8)	1 (1%)	2 (3%)	
Q6. Do you use fluoride toothpaste to brush your child's teeth?*			
Yes, I use fluoride toothpaste	83 (57%)	66 (89%)	<.001
No, I use toothpaste without fluoride	25 (17%)	7 (10%)	
No, I do not use toothpaste at all	9 (6%)	1 (1%)	
I am not certain if the toothpaste has fluoride in it	28 (19%)	0 (0%)	
Q7. How often are your child's teeth brushed?*			
Between 1-3 times a week	12 (8%)	0 (0%)	.040
Between 4-6 times a week	2 (1%)	0 (0%)	
Once a day	42 (29%)	15 (20%)	
More than once a day	88 (61%)	58 (78%)	
N/A	1 (1%)	1 (1%)	
Q8. Has your child's pediatrician prescribed fluoride drops or tablets for your child?			
No (skip to Q10)	59 (34%)	29 (35%)	.48
Yes	104 (59%)	51 (61%)	
Too young (<6 months) (skip to Q10)	13 (7%)	2 (2%)	
Unsure (skip to Q10)	0 (0%)	2 (2%)	
Q9. How often do you give your child fluoride drops or tablets?*			
Every day of the week	71 (68%)	30 (59%)	.63
4-6 days of the week	7 (7%)	3 (6%)	
1-3 days of the week	4 (4%)	2 (4%)	
I rarely give my child fluoride drops or tablets	17 (16%)	9 (18%)	
N/A	5 (5%)	7 (14%)	
Q10. Has your child ever had fluoride varnish applied to their teeth?			
No	57 (33%)	21 (25%)	.002
Yes	85 (49%)	57 (68%)	
Too young (<6 months)	33 (20%)	4 (5%)	
Other	0 (0%)	2 (2%)	
Q10 (Restricted to children aged >6 months).			
No	50 (33%)	16 (22%)	.016
Yes	84 (56%)	56 (76%)	
Too young (<6 months)	16 (11%)	1 (1%)	
Other	0 (0%)	1 (1%)	
Q11. How important are your child's primary teeth (baby teeth) compared to their permanent teeth (adult teeth)?			
Extremely important	170 (97%)	82 (98%)	.26
Moderately important	4 (2%)	2 (2%)	
Somewhat important	2 (1%)	0 (0%)	
Not important at all	0 (0%)	0 (0%)	

Table 2. Oral Health Questionnaire at Baseline and Post Intervention (Continued)			
Question (Q)	Baseline (n=176)	Post Intervention (n=84)	P-value
Q12. When was the last time your child saw the dentist?			
Within the past 6-12 months	112 (64%)	61 (73%)	.34
Within the past 1-2 years	2 (1%)	0 (0%)	
Over 2 years ago	1 (1%)	0 (0%)	
My child has never been seen by a dentist (skip to Q14)	39 (22%)	12 (14%)	
Too young (<1 year old) (skip to Q14)	21 (12%)	11 (13%)	
Not answered (skip to Q14)	1 (1%)	0 (0%)	
Q13. What were the reasons your child was brought to the dentist?*			
Regular check-up and cleaning	100 (87%)	56 (93%)	.26
Tooth pain	0 (0%)	0 (0%)	
To have a cavity filled	11 (10%)	1 (2%)	
Other	3 (3%)	3 (5%)	
N/A	1 (1%)	0 (0%)	
Q14. While you were pregnant with your child how many times did you visit the dentist?			
3 or more times	1 (1%)	0 (0%)	.004
2 times	11 (6%)	13 (16%)	
1 time	46 (26%)	27 (32%)	
I never saw a dentist when I was pregnant (skip to Q16)	117 (67%)	44 (52%)	
Not applicable – I am not the child's mother? (skip to Q16)	1 (1%)	0 (0%)	
Q15. What were the reasons you went to see the dentist while you were pregnant?*			
Regular check-up and cleaning	44 (76%)	31 (78%)	.30
Tooth pain	6 (10%)	2 (2%)	
To have a cavity filled	1 (2%)	0 (0%)	
Other	3 (5%)	7 (18%)	
N/A	4 (7%)	0 (0%)	
Q16. When was the last time you saw a dentist?			
Within the past 6-12 months	62 (35%)	36 (43%)	.85
Within the past 1-2 years	48 (27%)	18 (21%)	
Over 2 years ago	66 (38%)	30 (36%)	

Generalized McNemar's test was conducted to compare significant changes between baseline and post-intervention. Unsure and N/A were treated as missing and zero values were replaced by 0.001 to make a meaningful result.

* The total is smaller than the total number of the subjects who completed the survey (n=176 for baseline; n=84 for post-intervention) because of the skipped pattern from a previous question.

Follow-up Visit Analysis

Table 2 also shows follow-up visits. Of the 81 parents/guardians completing the initial questionnaire and receiving oral health education, 40 parents/guardians representing 84 children completed the follow-up questionnaire. This represents a completion rate of 49% (40 of 81) among families and 48% (84 of 176) among children. Five questions showed significant improvement over time. Table 3 presents the results from generalized estimating equations for the 3 follow-up visit questions that demonstrated significant changes in families' oral health behaviors over time.

The intervention had a positive impact on the family's oral health behaviors. Parents were 6.61 times as likely to report using fluoride toothpaste in the follow-up visit compared to their

initial visit (95% CI 3.12-14.00). There was also a statistically significant change in the frequency of children's daily tooth brushing (OR=2.15, 95% CI 1.33-3.46), as well as a significant change in the incidence of children receiving fluoride varnish application over time (OR=2.66, 95% CI 1.50-4.73).

Parents who returned for the follow-up visit at the WIC Clinic were also asked to respond to 2 additional questions related to their acceptance and willingness to provide fluoride oral supplements to their children and their support of the use of fluoridated water for their children. Overwhelmingly, 98% of parents stated they would give fluoride drops or tablets every day and 89% would support water fluoridation if they knew these actions would result in a reduction of caries for their children.

Table 3. Odds Ratios and 95% Confidence Intervals of Mixed Effects Logistic Regression			
Variable	Question (Q)6. Do you use fluoride toothpaste to brush your child's teeth? ^a [Yes vs. No/Uncertain]	Q7. How often are your child's teeth brushed? ^a [More than once a day vs. ≤ Once a day]	Q10. Has your child ever had fluoride varnish applied to their teeth? ^b [Yes vs. No/Other]
Time			
Post vs. Pre	6.61 (3.12-14.00)***	2.15 (1.33-3.46)**	2.66 (1.50-4.73)**
Child's Age			
5-8 yrs. vs. 1-4 yrs.	3.00 (1.41-6.38)**	1.87 (0.86-4.09)	6.61 (3.22-13.55)***
>9 yrs. vs. 1-4 yrs.	2.83 (1.03-7.75)*	0.93 (0.38-2.28)	7.56 (2.71-21.08)***
Parent's Marital Status			
Married or cohabitated vs. Other	2.16 (0.89-5.20)+	0.31 (0.11-0.85)*	1.07 (0.51-2.24)
Parent's Age (in yr)	1.00 (0.94-1.06)	1.02 (0.96-1.08)	1.07 (1.01-1.13)*

+*P*<.01. **P*<.05. ***P*<.01. ****P*<.001. ^a Restricted to children of age ≥ 1 year. ^b Restricted to children of age ≥ 6 months. Unsure and N/A were treated as missing.

Discussion

The results of the KMCWC WIC Clinic Project provide further evidence that initiating a simple educational intervention can have a positive impact on oral health behaviors in groups that are at highest risk for developing dental disease in Hawai'i. Significant changes in parents' approaches to oral health for their children were observed after the educational intervention during the initial visit with participants. This intervention consisted of a simple and short (ie, less than 10 minutes) discussion about preventive oral health measures for children and pregnant women. It resulted in a significant increase in the frequency that children's teeth were brushed, the use of fluoride toothpaste, and having fluoride varnish applied to children's teeth. Similar results have been reported in WIC Clinics in the US; however, this is a new approach to documenting oral health behavior change via an education initiative at WIC Clinics for the State of Hawai'i.

Information about the educational attainment of the participants in this project revealed that a majority had completed a high school education but only one-third had completed any course work at a college level. This is important to consider when developing and implementing interventions to increase knowledge about oral health or other health related issues, so that educational sessions and materials are organized and described at a literacy level that promotes understanding and integration of key messages. In addition, it is important to adapt and translate educational materials into the WIC Clinic client population's first languages as English may be a new language for clients receiving services at WIC Clinics.

Project Limitations and Barriers

There are several key findings that have been identified by this study; however, there are also limitations that need be noted. This project was conducted at the KMCWC WIC Clinic located in Honolulu on O'ahu. The data obtained and analyzed for

this project reflects the characteristics of women and children receiving services at a tertiary care medical center located in the capital city for the State of Hawai'i. Therefore, the generalizability of the findings of the project cannot be extrapolated to the neighbor islands and rural areas of the state.

Almost half of the clients who participated in the initial visit for the project returned on the scheduled day initially agreed upon to complete follow-up questionnaires, thereby providing data for analysis regarding parental oral health behavior change for their children. However, the inability of the researchers to be notified of clinic appointment changes by the families in a timely manner increased the number of families that were not seen for a follow-up survey and education during the approved study period. This reflects a respectable follow-up visit rate; however, the responses of these clients cannot be interpreted to represent those of the clients who participated in the initial project visit but did not return for the follow-up visit.

All educational materials used as part of this project were written in English. Although clients participating in the project stated that they could read English, English was not the preferred language of all participants. Because interpreter services are not offered by WIC Clinics, some of the content of the oral and written education materials for the project may have been less effective in achieving parental behavior changes due to language barriers.

One of the goals of this project was to improve the oral health of pregnant women. However, only 4 pregnant women agreed to participate in the educational intervention of this project, thereby preventing any analysis or interpretation of findings about their experiences of accessing dental care. Pregnant women are an important group that needs to have more comprehensive information collected and analyzed about their dental care so that feasible interventions can be developed, implemented, and evaluated to improve their oral health.

The project did not include an assessment of client satisfaction with or feedback about the educational sessions and referrals to dental care. This is an important aspect of any project that attempts to improve health care access, including dental care.

Conclusion

The relationship between nutrition, oral health, and systemic health is well documented; therefore, the integration of oral health education into the content of WIC Clinic visit for families is an ideal opportunity to impact overall health. In addition, the frequency at which WIC Clinic visits occur lends itself to repeated messaging about the importance of oral health for families.

Based on the information obtained from the KMCWC WIC Clinic Project, future program strategies can be developed, implemented, and evaluated to assist in successfully educating residents of Hawai'i who are at risk for adverse health outcomes associated with dental decay and transitioning them to dental providers in the community who are both willing and able to care for these clients' specific dental needs.

Conflict of Interest

None of the authors identify a conflict of interest.

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Methamphetamine Use in Pregnant Women in Hawai'i: A Case Series

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Abstract

Methamphetamine use is widespread among pregnant and reproductive-aged women in Hawai'i. Women who use methamphetamine require comprehensive care that is gender specific and tailored to their needs. In Hawai'i, more services are needed to solve this serious public health problem. The authors present three cases of methamphetamine use with negative maternal and fetal outcomes. The first case describes a pregnant woman with daily methamphetamine use who experienced cardiac arrest with subsequent preterm delivery and maternal death due to global anoxic brain injury. The second case describes a pregnant woman with daily methamphetamine use which exacerbated her chronic hypertension and led to intrauterine fetal demise. The third case describes a pregnant woman with current methamphetamine use who experienced preeclampsia and a cerebrovascular accident necessitating preterm delivery. Methamphetamine remains a serious public health concern for the United States and especially in the state of Hawai'i.

Keywords

Hawai'i, Methamphetamine, Pregnancy

Abbreviations

ACE = Adverse childhood experiences

HACA = Hypothermia after cardiac arrest protocol

MRI = Magnetic resonance imaging

SGA = Small for gestational age

Introduction

Methamphetamine is a stimulant that causes the release of dopamine, norepinephrine, and serotonin. It is usually smoked or snorted and causes increased energy, euphoria, weight loss, tooth decay, irritability, anxiety, paranoia, memory impairment, and can exacerbate pre-existing psychiatric conditions.¹ In general, amphetamine stimulants, including methamphetamine, are the most rapidly increasing class of illicit drugs used worldwide. Approximately 4.7 million people in the United States have tried methamphetamine.¹ Methamphetamine is one of the most addictive substances even after first time use and has been proven to change signaling pathways in the brain in rat models.² Mortality from methamphetamine use is high with approximately 10,333 drug overdose deaths in 2017, a rate which has tripled since 2011.³

Amphetamine use including methamphetamine has been increasing in reproductive-aged women, including pregnant women. A recent study looking at drug abuse hospitalization from 1998 to 2004 noted that, among hospitalized pregnant patients, co-

caine use had decreased by 44% whereas amphetamine use had doubled.⁴ Another study examined trends from 1994 to 2006 and found that the incidence of hospitalized pregnant women using methamphetamine increased from 8% in 1994 to 24% in 2006.⁵ The majority of these occurred in the western United States.

Amphetamines and their byproducts cross the placenta to the fetus. Amphetamine use is associated with a two to fourfold increase in intrauterine growth restriction, hypertensive diseases of pregnancy, placental abruption, preterm delivery, intrauterine fetal demise, and neonatal and infant death.⁶ Studies have consistently shown an increased rate of small for gestational age (SGA) babies among users. A prospective study identified a 3.5 times higher risk of SGA neonates with prenatal methamphetamine exposure.⁷ Neonates exposed to methamphetamine have lower Apgar scores and increased neonatal mortality.⁸ Long term effects in prenatally exposed children include increased stress, lower attention, verbal memory, and spatial memory.⁹

Three cases of methamphetamine use during pregnancy are presented. These cases demonstrate the immediate and long-term negative effects for both mother and neonate. Case 1 shows an example of maternal and neonatal mortality related to methamphetamine use. Case 2 shows an example of fetal demise related to methamphetamine use. Case 3 shows an example of long-term maternal morbidity related to methamphetamine use.

Case One

A 35-year-old Gravida 4 Para 2 Aborta 1 woman at 34 weeks and 4 days gestation was brought to the emergency department via ambulance due to cardiac arrest at home. Her prenatal course was significant for longstanding history of methamphetamine-induced cardiomyopathy, history of cardiac arrest, previous suicide attempt, and one prenatal visit. Her boyfriend awoke to find her gasping for air and soon after unresponsive. He immediately called 911. Intubation and CPR were performed in the field. Return of spontaneous circulation was achieved 14 minutes later. Upon arrival to the emergency department, she was hypoxemic, placed on hypothermia after cardiac arrest protocol (HACA), and developed pulmonary edema. The fetal heart rate tracing demonstrated a deceleration that lasted for 17 minutes down to a nadir of 50 beats per minute. An emergent cesarean delivery was performed. A live preterm female neonate was stabilized and transferred to another facility where neonatal intensive care services were available. She was transferred to the medical intensive care unit and completed the HACA proto-

col. Neurologic posturing was noted consistent with an anoxic brain injury. An echocardiogram revealed poor cardiac function with an ejection fraction of 10-15% and diffuse hypokinesia. An electroencephalogram showed delta-theta slowing with no reaction to painful stimulus. Computed tomography (CT) of the head demonstrated diffuse sulcal effacement with loss of gray-white differentiation, consistent with severe global anoxic/ischemic injury. On postoperative Day 5, she developed seizures. On postoperative day 12, her family withdrew life support. Shortly after, her death was pronounced. The neonate suffered from severe hypoxic ischemic encephalopathy. At 4 weeks of age, the family withdrew life support and the neonate also died.

Case Two

A 30-year-old Gravida 3 Para 2 woman at 28 weeks and 4 days gestation presented to a prenatal visit. She complained of blurry vision and headaches for the past two days. She last felt fetal movement three days prior. Her prenatal course was significant for late onset of prenatal care, uncontrolled hypertension for over 10 years, and daily methamphetamine use. Her blood pressure was 179/121. Severe superimposed preeclampsia was diagnosed based on persistent central nervous system symptoms, new onset 4+ proteinuria, and persistent severe blood pressure readings. An obstetric ultrasound revealed an intrauterine fetal demise measuring 23 weeks and 3 days. The woman was treated with intravenous magnesium for seizure prophylaxis, intravenous and oral labetalol, labor was induced, and she vaginally delivered a macerated stillborn male that appeared grossly normal.

The woman reported that her other children had been removed from her custody and were living separately from each other with extended family on the mainland. She stated that her current boyfriend also used methamphetamine regularly. She was amenable to treatment and elected to stay at a residential treatment center. Her blood pressure required multiple medications to achieve control. She was then discharged on postpartum day two with prescriptions for four antihypertensive medications. Four years later, she was seen in the maternal fetal medicine office for another pregnancy. She was incarcerated. She hoped to re-enroll in a residential treatment program after release.

Case Three

A 27-year-old Gravida 3 Para 2 woman at 31 weeks and 6 days gestation with chronic hypertension with superimposed preeclampsia was transferred by air ambulance from a neighbor island to Honolulu. Her prenatal course was significant for current methamphetamine use, scant prenatal care, history of two prior preterm deliveries due to severe preeclampsia, and history of a classical cesarean delivery. She reported that her younger child born at 24 weeks had been removed from her care and was adopted by a foster family. Her blood pressure was controlled with an oral antihypertensive medication and the fetal status was reassuring. She experienced rapidly progressing

lower extremity weakness and urinary and fecal incontinence over several hours. There were no other neurological findings. She had normal capacity, but behaved impulsively and belligerently. Lumbar magnetic resonance imaging (MRI) showed disc protrusion at the L1-2 level and diffuse disc bulging at L3-4 and excluded cauda equina syndrome. She was transferred to another hospital where on site neurology and neurosurgery were available. An MRI of her brain, cervical, thoracic, and lumbar spine were ordered and ultimately performed three days later due to patient refusal. The MRI revealed multiple tiny infarcts in the bilateral frontal lobe, right parietal lobe, left occipital lobe, and right cerebellar hemisphere. An embolic cause was excluded. She received a negative transthoracic echocardiogram with bubble study, negative CT angiogram of the brain and neck, and negative CT venogram of the brain. A thrombophilia workup and lipid levels were normal. The final diagnosis was small acute infarcts caused by methamphetamine induced reversible cerebral vasoconstriction syndrome. Delivery by repeat cesarean delivery was performed at approximately 33 weeks gestation for the diagnosis of severe superimposed preeclampsia and brain ischemia. She requested and underwent tubal ligation which was performed immediately after delivery. The bowel and bladder incontinence did not reverse. On postoperative day four she was discharged from the hospital to follow-up in an outpatient stroke rehabilitation center, after she declined the recommended inpatient stroke rehabilitation. She has been lost to follow-up at the time of this writing. The neonate did well and was placed with the same adoptive family as her second child.

Discussion

There are significant maternal and fetal risks with methamphetamine use during and after pregnancy. The first case demonstrated the increased risk of cardiomyopathy and myocardial infarction leading to death. The second case demonstrated the increased risk of hypertension and intrauterine fetal demise, as well as the consequences of incarceration and separation of families. The third case demonstrated the increased risk of stroke and permanent neurologic damage.

Methamphetamine use is linked to early mortality and with a significantly higher rate of suicide attempts regardless of age and socioeconomic status.¹⁰ The rate of methamphetamine-associated cardiomyopathy has increased from 1.8% in 2009 to 5.6% in 2014.¹¹ A recent study conducted in Hawai'i found that pregnant women who used illicit substances (the majority of whom used methamphetamine) have increased parity, more frequent use of tobacco and marijuana, are more likely to identify as Native Hawaiian or other Pacific Islander, and more often have diagnoses of schizophrenia, schizoaffective disorders, or post-traumatic stress disorder when compared to pregnant women who did not use illicit substances. Pregnant women who used methamphetamine were more likely to present later for care and to have fewer prenatal visits. Birth outcomes

were significant for preterm delivery and lower birth weight among continuous methamphetamine users and an increase in chronic hypertension and cesarean delivery among occasional methamphetamine users.¹²

Methamphetamine use also affects breastfeeding and may decrease maternal bonding. Breast milk concentrates amphetamines between 2.8-7.5 times higher than in maternal blood and thus women intermittently using methamphetamine are advised to wait or discard milk for 48-100 hours after use, a timeline which is unrealistic for those that use frequently.¹³ Infants who ingest breast milk with amphetamine demonstrate increased frequency of irritability, agitation, and crying.¹⁴ Women with chronic use resulting in brain dysregulation may find breastfeeding overwhelming or impossible. Maternal behavior may become disrupted where stress becomes heightened by neonate behavior instead of what would normally be rewarding to mothers without a substance use disorder.¹³

Methamphetamine remains a serious public health concern for the United States and the state of Hawai‘i. In the United States, costs associated with methamphetamine have risen from \$436 million in 2003 to \$2.2 billion in 2015.¹⁵ Methamphetamine has become the drug of choice in Hawai‘i. In 2004, there were approximately 30,000 methamphetamine users in Hawai‘i who spent a total of approximately 1.8 billion dollars annually due to their habits.¹⁶ The state of Hawai‘i spends approximately half a billion dollars per year on programs related to methamphetamine use and this cost has increased in the past few years.¹⁶ In comparison, Montana spends approximately \$300 million per year on methamphetamine related issues.¹⁷ In 2014, the drug overdose death rate in Hawai‘i was 10.6 per 100,000 residents, which far surpassed the motor vehicle death rate of 6.5 per 100,000. Between 2010 to 2014, 91% of all poisoning deaths were due to drug overdoses.¹⁸ According to the Hawai‘i Pregnancy Risk Assessment Monitoring System, 3% of pregnant women in Hawai‘i in 2014 reported use of any illicit drugs including methamphetamine during their most recent pregnancy.¹⁹ This is slightly lower than the national average of 5.4% averaged across 2012 and 2013.¹⁵ Hawai‘i was ranked number one in 2017 for drug-related hospital admissions concerning methamphetamine.²⁰ The Queen’s Medical Center, Hawai‘i’s only Level One Trauma Center, and its West O‘ahu Campus have noticed a sharp increase in patients affected by methamphetamine use. Of patients who present to the emergency department, 20-40% have methamphetamine related issues. Admissions related to methamphetamine use have quadrupled in the past 10 years.²⁰

Treatment of methamphetamine intoxication includes intravenous fluids, sedation with benzodiazepines, diphenhydramine, antipsychotics, and blood pressure and heart rate control. There is a longstanding dogma that beta-blockers, including labetalol, should not be used to treat hypertension with concomitant methamphetamine exposure or toxicity. This recommendation is based on a small number of cocaine toxicity cases, which have

perpetuated a theoretical concern regarding “unopposed alpha stimulation” when beta blockers are used. This side effect has not been demonstrated in cases of methamphetamine toxicity. Labetalol is a nonselective beta-blocker with selective alpha one blocking effect with weak intrinsic sympathomimetic activity. It is also one of the first line antihypertensive medications for use during pregnancy. According to a systemic review in 2015, for concomitant tachycardia and hypertension that does not respond to sedation, labetalol is the preferred treatment due to its alpha blocking ability.²¹ It predictably reduces blood pressure and heart rate and has the added advantage of being lipophilic, thus penetrating the blood brain barrier and decreasing agitation.²²

It is extremely beneficial to keep the mother and baby dyad together for both maternal and child health. Gender specific treatment is necessary, recognizing that many patients are single mothers who need help with housing, childcare, and transportation to effectively participate in treatment. Women who use substances benefit from trauma informed care as they are frequently victims of adverse childhood experiences (ACE), including neglect, deprivation, sexual and physical abuse, and parental substance use. ACEs also increase the rate of chronic conditions, decrease the quality of life, and life expectancy. There are higher rates of resilience among children receiving care in family-centered medical homes.²³ Separation is reserved for severe cases where the mother is unwilling or unable to seek treatment or unable to safely care for the child. Benefits for the mother include bonding which may be a strong motivation to stop use. Benefits for baby include bonding with the mother and breastfeeding, if feasible.⁶ Families coping with substance use disorder would benefit greatly from the well-known health benefits of breastfeeding that include child spacing, decreased rates of infection, sudden infant death syndrome, and postpartum depression.¹³

There are not enough substance use treatment programs available in the state of Hawai‘i to meet the needs of women. This is especially true in the more rural neighbor islands, as demonstrated by the fact that in 2014, 28 of the 52 publicly funded treatment programs were located on O‘ahu.²⁴ The island of O‘ahu has capacity for less than 100 women, and only one residential treatment program allows women to live with or bring their children to the treatment center. As a result, waiting lists are months long. There are no residential treatment programs on the island of Kaua‘i. Other states suffer from similar problems and have tried a variety of approaches.¹⁵ Vermont has established telehealth programs to improve capacity. Ohio recommended increasing the number of addiction doctors who work in treatment programs. Montana attempted to use graphic advertising as a way to prevent first time use among teenagers; however, it was criticized as making the drug seem less risky and more acceptable to teenagers. California implemented a community-based drug treatment and probation program for offenders convicted of a nonviolent drug-related crime. They found a benefit cost ratio of four to one for participants who

completed the program, resulting in a net savings of \$173.3 million.²⁵ Kansas started a prevention project that supported local community efforts to prevent the manufacture and use of methamphetamine and saw a significant reduction in the use of methamphetamine in high school seniors.²⁶ Hawai'i has just started an addiction medicine fellowship that will help address the physician shortage of people specifically trained to deal with substance use disorders.

In conclusion, methamphetamine use remains a serious public health problem for Hawai'i's women, children, and families. Methamphetamine use causes significant maternal, fetal, and neonatal morbidity and mortality, all of which negatively affect the whole of society. Currently, there are insufficient services in Hawai'i to support and treat pregnant and reproductive-aged women who are using methamphetamine and other drugs. More social services that destigmatize the issue and provide gender specific care are needed.

Conflict of Interest

None of the authors identify any conflict of interest.

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Keiki Produce Prescription (KPRx) Program Feasibility Study to Reduce Food Insecurity and Obesity Risk

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Abstract

One in 6 US children experience food insecurity, signifying that at some time during the last year their household did not have sufficient food, money, or resources to feed their family. These children experience little intake of fresh fruits and vegetables (FV), a risk factor for chronic disease, including obesity. Produce prescription programs provide vouchers to purchase fresh FV at participating retailers. The Keiki Produce Prescription (KPRx) Program feasibility study was conducted through a partnership between the Waianae Coast Comprehensive Health Center's Pediatrics and Health Promotion Department's Farmers' Market and the University of Hawai'i nutrition faculty. Pediatricians provided patients with a prescription (Rx) to purchase FV from the Farmers' Market (\$24 per month for three months). Of the 193 Rx distributed, 125 patients participated in part of the program, while 34 completed the full program. Parents, pediatricians, clinic staff, and community members expressed overwhelming support of the program. Parents of participating children completed an exit interview that identified themes surrounding motivation to participate, benefits to child and family, and future recommendations. It identified the need to improve program retention efforts. Participants reported lifestyle benefits for both the child and family and recommended educational resources. A research protocol was developed to address the following objectives: (1) streamline referrals, (2) enhance retention, (3) quantify program impact, and (4) identify barriers to participation. Subsidies have the potential to increase FV consumption, improve overall health, reduce chronic diseases in adulthood, and result in substantial healthcare cost savings.

Keywords

Farmer's market, Federally Qualified Health Centers, Food access, Food insecurity, Fruit and vegetables, Low-income communities

Abbreviations

EMR = Electronic medical record
FQHC = Federally Qualified Health Center
FV = Fruits and vegetables
KPRx = Keiki produce prescription
MF Market = Mākeke Farmers' Market
NHOPI = Native Hawaiian or Other Pacific Islander
Rx = Prescription
SNAP WIC = Special Supplemental Nutrition Program for Women, Infants, and Children
WCCHC = Wai'anae Coast Comprehensive Health Center

Introduction

One in 6 children in the United States (US) live in households that experience food insecurity, signifying that at some time during the last year, their household did not have sufficient food,

money, or resources to feed their family.¹ Children living in food-insecure homes experience low intake of fresh fruits and vegetables (FV) and are at high risk to suffer from overweight or obesity, setting a trajectory for chronic disease in adulthood.²⁻⁴ In Hawai'i, a higher proportion of Native Hawaiian and other Pacific Islander (NHOPI) children live in food-insecure households when compared with the state average (30% and 50%, respectively vs 18%), and 31% of NHOPI children are overweight or obese compared to 27% nationally.⁵⁻⁷ Interventions to improve food insecurity may be an ideal way to improve FV intake and reduce obesity-related health disparities in NHOPI and other children from low-income households.

In adults, increased FV intake is associated with reduced risk of cardiovascular disease, cancer, and premature mortality, while food insecurity is associated with elevated risk.^{8,9} Predictive models demonstrate that prescriptions (Rx) for healthy food, equivalent to a 30% subsidy for FV for Medicare and Medicaid recipients, could increase FV intake by 0.4 servings per day, preventing up to 2 million cardiovascular disease events and yielding \$39.7 billion in health care cost savings.¹⁰

Clinical and community-based interventions to improve FV intake in children have had limited success, with few addressing food insecurity in young families.^{11,12} Adult produce prescription (Produce Rx) programs provide vouchers to purchase fresh FV at a specified retail outlet. Evidence suggests that these programs decrease household food insecurity, increase FV consumption, and improve chronic disease management in adults.¹³ Just \$11 per month in FV vouchers was effective in increasing FV intake and reducing food insecurity in low-income children and adults who participated in the federally-funded Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program.¹⁴ Further, WIC participants who used vouchers at farmers' markets were twice as likely to consume the recommended number of FV servings per day (odds ratio [OR]= 2.01, 95% confidence interval [CI]=1.15-3.5).¹⁵ The Wholesome Wave FV Rx program provided FV vouchers to obese children through health care providers at nine Federally Qualified Health Centers (FQHCs) across the United States.¹⁶ The 4- to 6-month intervention enrolled 900 predominately Hispanic or Latino households. Of the 578 who completed the study, there was a significant improvement in food security status (58% vs 76%) and FV consumption (from 2.8 cups/day to 3.1 cups/day).^{16,17}

Health care providers are a potential, underused resource for screening and providing resources to address social determinants of health such as food insecurity.^{16,18} Evidence shows that health care providers can be a “catalyst for change” and impact patient behavior, especially if advice is paired with information and activities that reinforce healthy behaviors.¹⁹ Together, this suggests that interventions aimed at simultaneously reducing food insecurity and increasing FV consumption initiated by healthcare providers and supported by community resources and activities can improve diet and yield significant reductions in health disparities.

While FV incentive programs aim to improve access to and consumption of FV, many patients experience barriers to participation which limit program effectiveness on diet and health outcomes.^{18,20,21} Studies have found inconsistent redemption rates for WIC FV vouchers, citing negative stigma,²⁰ transportation barriers,¹⁵ limited availability of farmers’ markets, inconvenience, and limited quality or variety of FV as significant barriers.²¹ However, there is limited information on factors that influence program participation, including strategies to augment participation in indigenous children from rural communities, including NHOPI. Figure 1 illustrates the pathway to improved health that serves as a framework for FV Rx programs. This paper describes the results of a feasibility study of a community-based pediatric FV Rx program, including support and barriers to participation, and the recommendations for future research.

Methods

The feasibility evaluation took place on the Wai‘anae Coast of O‘ahu, a rural community near Honolulu (population of 43,609), with a high proportion of NHOPI residents (37%). The Wai‘anae Coast Comprehensive Health Center (WCCHC) is the state’s largest FHQC and the leading healthcare and safety net provider on the Coast. To meet the needs of the community, WCCHC’s Health Promotion Department sponsors community food pantries and the Mākeke Farmers’ (MF) Market. MF Market has

three convenient locations along the Wai‘anae Coast and was O‘ahu’s first Farmers’ Market to accept Supplemental Nutrition Assistant Program (SNAP) benefits. Each week approximately 1,600 individuals shop with the MF Market’s more than 35 vendors. The MF Market often provides health education and food demonstrations to shoppers through vendors, the WCCHC Health Promotion staff, and community partners.

The *Keiki* (child) Produce Rx (KPRx) Program is a FVRx program that was developed, implemented, and evaluated through a partnership between the WCCHC Pediatric Clinic, WCCHC Health Promotion Department, and University of Hawai‘i nutrition faculty. Prior to implementing the program, WCCHC’s Health Promotion Department educated pediatric clinic providers and staff about food insecurity, the MF Market services and schedule, and the KPRx. For this feasibility evaluation, partners decided that participants would include children ages 2 to 17 years with “poor nutrition,” based on growth assessment or body mass index percentile for age/sex < 5% or >85%.²² Pediatricians invited eligible patients with their parents or caregivers to participate in the program and clinic staff provided the Rx and informational flyer. Eligible children were invited to participate in the program if a parent was present at the office visit. The child was considered the program participant. Parents received a Rx for each eligible child. Each Rx was good for \$72 in fresh FV (\$24 per month for 3 months). Distribution of KPRx from the pediatric clinic took place between July 2018 and April 2019. Figure 2 depicts the KPRx provided by the pediatrician.

Parents, with or without their child, brought the Rx to the MF Market and exchanged it for vouchers valid for \$24 a month for three months, in fresh FV sold by MFMarket vendors. Vouchers were labeled by participant number in order to track redemption. MF Market vendors were informed of the program and provided instruction on eligible purchases. Vouchers themselves were also labeled with allowable purchases (fresh FV only). MF Market and evaluation staff at the MFMarket information

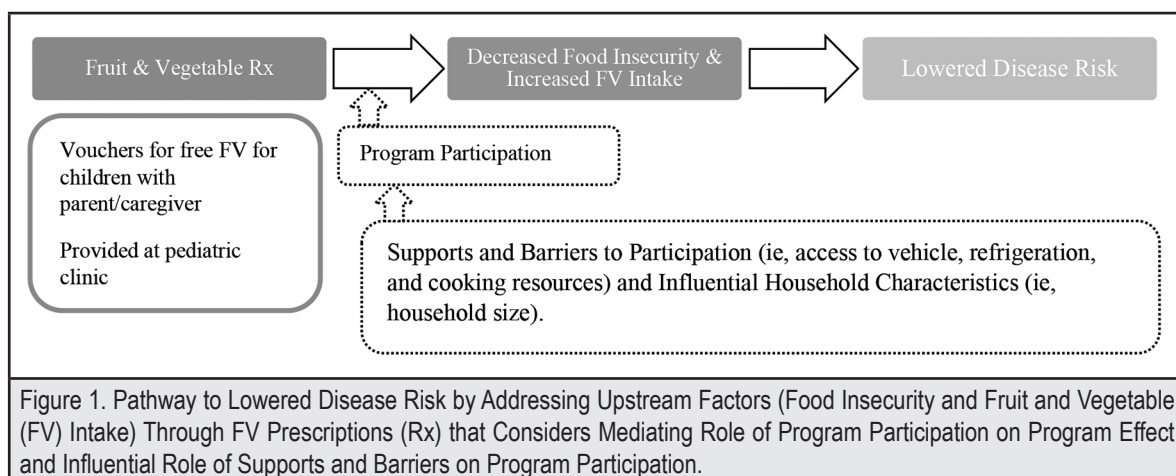


Figure 1. Pathway to Lowered Disease Risk by Addressing Upstream Factors (Food Insecurity and Fruit and Vegetable (FV) Intake) Through FV Prescriptions (Rx) that Considers Mediating Role of Program Participation on Program Effect and Influential Role of Supports and Barriers on Program Participation.

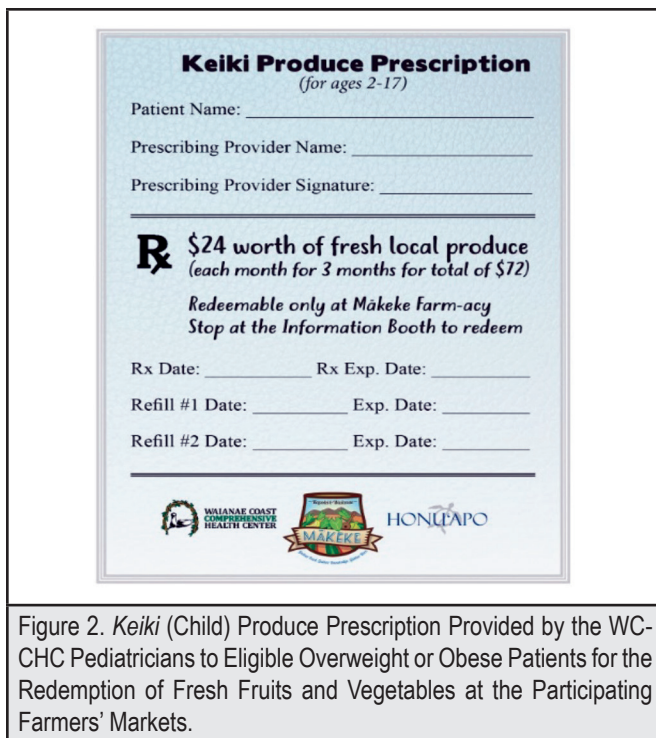


Figure 2. Keiki (Child) Produce Prescription Provided by the WC-CHC Pediatricians to Eligible Overweight or Obese Patients for the Redemption of Fresh Fruits and Vegetables at the Participating Farmers' Markets.

booth were the primary point of contact for KPRx parents and were responsible for providing vouchers, tracking pick-up and redemption, and collecting Keiki Surveys.

Upon completion of the program (defined as redemption of 100% of vouchers), the program assistant contacted parents who had shared their information with the evaluation team, to schedule an interview. Interviews were conducted at the MF Market or over the phone and lasted approximately 15 minutes. Final interview questions are listed in Table 1. Parents of participants were provided an additional \$25 MF Market gift certificate for completing the final interview. Parents who had more than one child in the program completed only one interview, representing all of their children. Responses were transcribed by the program assistant.

Data Analysis

Patterns of participation including Rx distribution by the pediatricians, voucher pick-up and redemption, and Keiki Survey completion were examined. Two researchers analyzed the interview responses independently, then jointly discussed themes to develop a final codebook. Parent statements were coded. The frequency of a theme was quantified by the individual number of times it was mentioned in the responses and frequency by participant. Quantitative data was analyzed using Microsoft Excel (Microsoft Corporation: Redman, Washington). Qualitative data was analyzed manually to identify recurrent themes.

Table 1. Keiki Produce Prescription Program Feasibility Evaluation Exit Interview Questions for Parent/Caregivers.
How did you use the prescriptions?
Which fruits and vegetables did you purchase most often with the prescriptions and why?
Why did you choose to participate in the program?
How did the "farm-acy" prescriptions change you or your family's eating habits?
How has your keiki's feelings towards eating fresh fruits and vegetables changed since starting the program?
If answered positively to the last 2 questions, how do you think you will maintain the changed eating habits or attitudes after the prescription program?
Tell me about your experience in the process of getting the prescription at the doctor's office?
What else could we provide to make it easier for you and your family to get more fresh fruits and vegetables into your home?
What additional information could we provide to you that would make it easier for you and your family to eat more fruits and vegetables in your home?
Do you have any suggestions on how to improve the program?
Is there anything else you would like to share with us?

This feasibility program evaluation was deemed exempt from the Waiānae Coast Comprehensive Health Center Institutional Review Board.

Results

Of the 200 KPRx available, WCCHC pediatricians distributed 193 (97%), and 122 (63%) Rx were at least partially redeemed (Table 2). Thirty four (17%) participants redeemed all their vouchers (\$72 in total) (Table 2). The parents of participants who redeemed all vouchers were contacted for final interviews. Thirty-three participants were represented in final interviews with 21 different parents. The average age of the participating children was 8 years.

Themes identified from the interviews were grouped into the following categories: (1) factors influencing program participation, (2) program effect on children and their families, (3) most enjoyable program components, and (4) factors influencing purchasing decisions. Table 3 outlines themes identified from the interviews.

Factors Influencing Participation

Four themes emerged regarding factors that influenced program participation: (1) increasing affordability and accessibility of FV for the family, (2) supporting child diet and/or interest in attending the farmers' market, (3) receiving encouragement from the pediatrician, and (4) obtaining the FV Rx easily.

Program Effect on Children and Their Families

Four themes emerged regarding effects of the program: (1) the program resulted in family lifestyle changes, (2) improved eating habits, (3) introduction of new FV in the home, and (4) child lifestyle changes such as increasing FV consumption and decreasing processed food consumption. One parent shared, “Knowing that you do have access to the produce allows you

to plan ahead. It makes you want to go to the farmers’ market more.” Participants cited improved household availability of FV (n=12, 57%) and increased awareness of the farmers’ market and the affordable produce available (n=5, 24%).

Components Enjoyed Most

Four themes emerged around the program components enjoyed by participants: (1) financial support for healthy food (n=13, 62%), (2) child involvement (n=9, 43%), (3) FV availability (n=5, 24%), and (4) MF Market (n=5, 24%) attendance. One parent shared, “I got to watch the boy go shopping for fruits and vegetables! He could afford to buy the ones he loved most.”

Influences on Purchasing Decisions

Two themes emerged around factors that influenced purchasing decisions. The first theme was familiarity with FV (n=21, 100%). This theme included parents’ awareness on how to prepare or cook a FV as well as the child’s preference or enjoyment of a particular fruit or vegetable. One parent expressed a response that others shared, “that’s what me and my kids like, and I cook with them (the vegetables).” The second theme was associated with influences on purchasing decisions, which included parents’ knowledge of recipes and meal planning (n=11, 52%).

Table 2. Keiki Produce Prescription Program Prescription Distribution and Voucher Redemption Rates.	
Total Prescriptions Available	200 (100%)
Number of Children who Received Prescription	193 (96%)
Number of Prescriptions Redeemed at Mākeke Farmer’s Market*	122 (63%)
Number of Children	
Partially redeemed (\$4-\$20) First Voucher	26 (13%)
Fully redeemed (\$24) First Voucher	96 (50%)
Partially redeemed (\$4-\$20) Second Voucher	15 (8%)
Fully redeemed (\$24) Second Voucher	59 (31%)
Partially redeemed (\$4-\$20) Third Voucher	10 (5%)
Fully redeemed (\$24) Third Voucher	47 (24%)
Fully redeemed All Vouchers (\$72)	34 (18%)

*Prescription redemption defined as the prescription from the pediatrician being brought to the Mākeke Farmers’ Market in exchange for first fruit and vegetable voucher (\$24 value).

Category	Theme	Theme Definition	Count (%)
Influencing factors on program participation	Increase affordability and accessibility	Financial help to offset the high costs of fruit and vegetable (FV) to make FV more available in the home	15 (72)
	Interest in supporting child	Interest in improving child’s diet and supporting the child’s interest in attending the farmers market and purchasing FV	8 (38)
	Communication with the pediatrician	Communication with the pediatrician and clinic staff, including informational flyers	11 (52)
	Easy experience in obtaining FV Rx	Easy and fast process in the clinic with staff and pediatricians	20 (95)
Program effect on participants and their families	Family lifestyle changes	Improved eating habits, increased interest in the farmers market, and the introduction of new FV	14 (67)
	Child lifestyle changes	Observed decrease in processed food and increase in FV consumption, increase in physical activity and interest in attending the farmers’ market	11 (52)
	Household accessibility and availability of FV	Increased accessibility and availability of FV in the home	12 (57)
	Increased awareness of the farmers’ market and affordability	Participants learned of the farmers’ market and overcame misconceptions about farmers’ markets being expensive	3 (14)
Most enjoyed program components	Financial help	Participants enjoyed the financial support	13 (62)
	Child involvement	Participants enjoyed the program’s impact on their child and the opportunity for their child to purchase their own FV.	9 (43)
	Fruits and vegetables	Participants enjoyed having FV as a result of this program	5 (24)
	Farmers’ Market	Participants enjoyed attending the farmers’ market due to its location and the opportunity to use the vouchers to buy local produce	5 (24)
Influencing factors on purchasing decisions	Familiarity	Participants purchased FV they were familiar with (knew how to prepare in many ways) or that their child preferred to eat	21 (100)
	Intent to prepare	Participants purchased FV that they had recipes for	11 (52)

Discussion

This KPRx program is both feasible and has the potential to improve FV intake in pediatric patients. Parents reported positive effects on diet and lifestyle for both the referred child and family. They indicated that the information and encouragement from the pediatrician had a positive influence on enrollment. Pediatricians are a trusted source of health information and long-term providers, which collectively motivate families to participate in obesity treatment interventions.²⁰ Moreover, the KPRx program enables pediatricians to support the families' ability to manage their food environment, a strategy endorsed by obesity experts.²⁰

Parents in the KPRx program reported great interest and increased access to FV for the child and family. This is important because inadequate access to FV contributes to poor FV intake in children from food insecure homes.²³ Parents reported increased awareness of MF Market's affordable produce and the enjoyment in going to the MF Market for themselves and their children. This is an important consideration in rectifying misconceptions that many parents, especially those from lower income and minority communities, have about farmers' market fresh produce prices being prohibitively expensive.¹⁵ While this feasibility study did not quantify the effects of the program on their child's diet, parents reported behaviors that implied active FV consumption activities (ie, children selecting and preparing the produce, parents planning meals, and preparing the FV at home).^{24,25} Parents also revealed that they purchased fruits and vegetables that they were most familiar with, supporting the potential benefit of food demonstrations and tastings to expand familiarity with a variety of produce items and methods of preparation.

This study focused on feasibility. The authors did not have the resources to track or reinforce child participation, quantify program outcomes, or implement strategies to increase retention. Consequently, the completion rate was low (17%). To improve participation and retention rate and quantify program effect, future studies should include the following components: (1) streamline referrals and communication between pediatricians and the MF Market staff, (2) enhance retention efforts through communication with parents and share strategies to support families to consume more FV, (3) quantify child and family FV consumption, and (4) identify barriers to participation. Parents expressed enjoyment in bringing their children to the MF Market and the support from the program staff to purchase and prepare healthy food. Future programs can leverage these factors and offer family-centered activities to encourage participation and attendance at the market.

This is the first study to explore the feasibility of a produce Rx program addressing food insecurity and childhood obesity risk in Hawai'i. The collaborative effort employed a unique community-based approach to program development, imple-

mentation, and evaluation. In addition to the limitations of this feasibility study mentioned above, an additional limitation was that interviews were conducted only with families who completed the full program, and did not consider the views and opinions of those families who did not complete the program.

Based on the present feasibility study results, the inherent limitations of this type of study, and input from program partners, a KPRx expanded research protocol was developed. The specific aims included: (1) to quantify the effects of the KPRx on child FV consumption and food insecurity status and (2) to identify facilitators and barriers to participation through qualitative interviews with parents and children. The expanded KPRx protocol is an ongoing study in progress with results that are forthcoming.

In summary, children living in food-insecure homes experience low consumption of fresh FV, and, consequently, suffer from an increased risk for obesity and chronic diseases in adulthood. Despite evidence on the beneficial effects of clinic-based produce Rx and other FV incentive programs have shown, evidence for the impact of these programs in children is lacking. This feasibility study demonstrated that a program of this kind may have a positive impact on children most at risk in Hawai'i. This study has also taken a purposeful approach to ensure that the process is driven from a community needs perspective, by engaging with clinic providers, the WCCHC Community Advisory Group, and from solicitation of feedback from the community, to both inform program content and in the development of the future research protocol. Future steps to ensure sustainability include demonstrating positive health outcomes to inform future health care policy to promote healthy eating behavior. Finally, the evolution of this program and the methods utilized could inform other organizations and communities who seek to implement multi-level approaches to reduce and/or eliminate health disparities by linking community and clinical expertise, participation and resources.

Conflict of Interest

None of the authors identified any conflicts of interest.

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Wellness Curriculum in the Pediatric Clerkship

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Abstract

Psychological distress leading to burnout is an important issue during medical school. While studies have researched interventions in the pre-clerkship years, very few have targeted the clerkship years. To improve the wellness of third year medical students, the following interventions were implemented: (1) prompted students to identify two wellness goals in the areas of personal and physical well-being and (2) encouraged students to participate in meditation and chair yoga sessions during their pediatrics clerkship. Students completed pre- and post-clerkship wellness surveys. The interventions led to a small but significant improvement in the wellness of students, particularly in mental, physical, emotional, social, and spiritual well-being. Further expansion of a wellness curriculum to all clerkships during the entire third and fourth years may result in reduced burnout and sustained improvements in wellness during post graduate training and practice.

Keywords

Pediatric clerkship, Wellness, Well-being

Introduction

Medicine is a demanding profession that can be a major source of stress, particularly during medical school and residency training. Psychological distress, including burnout, depression, stress, low mental and physical quality of life, and fatigue are common among medical students.^{1,2} As many as 50% of medical students report burnout during medical school and 11% report suicidal ideations.³ Stressors for medical students are multifaceted and include factors such as pressure to perform academically, difficulty navigating relationships with faculty, and balancing personal life with responsibility to patients.⁴ These stressors become magnified in the third year of medical school, when students begin their clinical rotations. Due to time constraints, third-year medical students struggle with making healthy choices, being good role models for patients, and applying the information they learn to their own health and wellbeing.⁵ Additionally, studies have shown that medical students, residents, and physicians have higher rates of burnout and depression compared to the general population because of these common stressors.⁶ The patterns of distress appear to be accentuated during medical school. Brazeau, et al, found that matriculating medical students who had not yet started medical school had lower rates of burnout and depression symptoms as compared to recent graduates.⁷ Thus, medical training is a contributing factor to the high rates of distress reported among developing physicians. These high rates of physiological distress are alarming because they increase the risk of negative

consequences, including higher rates of substance abuse, less empathy and regard for ethical conduct, and higher rates of relationship problems among physicians.⁸

Over the past decade, schools have initiated wellness programs into their curriculum to address high levels of psychological distress among students, especially during the preclinical years. Santen, et al, showed that high levels of social support helped to decrease burnout among first and second year medical students.⁹ A comprehensive wellness program initiated in the preclinical years at Vanderbilt University School of Medicine in 2005 included three components: (1) career and wellness advising, (2) a Student Wellness Committee to develop wellness activities, and (3) a longitudinal wellness curriculum with workshops and open discussions designed to spur student thoughts about wellness and self-care. This program was widely popular among medical students at Vanderbilt and became a national model for student wellness programs.¹⁰ Dr. Slavin, the keynote speaker at the 2015 Council on Medical Student Education in Pediatrics conference, implemented a preventive approach to student stressors at Saint Louis University School of Medicine in 2010. The goal of the intervention was to prevent stressors from occurring, rather than simply viewing them as an inevitable consequence of medical school. The implemented changes included (1) a pass/fail grading system, (2) simplifying pre-clinical course curriculum, (3) longitudinal electives, and (4) learning communities, such as service and wellness interest groups.¹¹ Comparison of pre- and post-curriculum change showed decreased rates of depression, anxiety, and stress in students.

While preclinical wellness programs adopted by medical schools have shown positive impact, less research has been done on the effect of initiating a wellness program during the clerkship years. We sought to foster wellness behavior in the third year of medical school, a time of learning and change for medical students as they adjust from preclinical to clinical activities. The purpose of this study was to build upon previous knowledge of successful wellness programs in the pre-clerkship years and evaluate a time-efficient and effective wellness program for medical students during their third-year pediatric clerkship that would help reduce burnout and improve overall quality of life.

Methods

This study instituted a wellness program for all third-year medical students at the John A. Burns School of Medicine during their Pediatric Clerkship rotation. The wellness program began

with a 15-minute orientation emphasizing the high incidence of burnout and the importance of maintaining wellness throughout medical training, and students were asked to identify two wellness goals in personal and physical well-being. Additionally, two wellness sessions were conducted approximately 2 weeks apart during the clerkship. Students discussed progress on their wellness goals at the wellness sessions. The clerkship administrator taught relaxation techniques during these two 30-minute sessions; the first session covered meditation techniques, and the second, chair yoga. At both sessions, the students were reminded of their wellness goals and the importance of maintaining physical and personal well-being throughout the clerkship. Students completed surveys, pre- and post-clerkship, and were assigned study subject numbers. The study subject numbers were only accessible to the clerkship administrator and kept in a locked office with a password protected computer; data was deidentified prior to analysis. The survey used was a shortened version of the American Association of Medical Colleges Medical Student Life Survey that has been validated by past research; scores range from 0-10 (Table 1).¹²⁻¹³ The electronic surveys were only sent to the students once before and once after the clerkship. A written consent was sent to the students with the electronic survey, informing them of the option for voluntary participation to complete the surveys. All students were allowed to participate in the wellness program regardless of their completion of the pre- and post-surveys. Reminder emails were not sent to students who did not complete the survey. All procedures were approved by the Institutional Review Board of the University of Hawai'i at Mānoa.

Data was compared for 108 (out of the 194) students who completed both the pre-clerkship and post-clerkship survey between July 2015 to August 2019. Pre- and post-intervention results were analyzed via paired t-tests. The change in scores for Fall (blocks 1-4, 63 students) vs the Spring (blocks 5-7, 45 students) were compared using t-tests. Data analysis was performed using AcaStat version 10.1.20 (AcaStat: Winter Garden, FL).

Table 1. Pre- and Post-Wellness Intervention Survey Questions	
On a scale from 0 to 10 (where 0 = As bad as it can be and 10 = As good as it can be), how would you describe your:	
Question 1:	Overall quality of life?
Question 2:	Overall mental (intellectual) well-being?
Question 3:	Overall physical well-being
Question 4:	Overall emotional well-being
Question 5:	Level of social activity?
Question 6:	Spiritual well-being?
Question 7:	Your level of fatigue on average?
Question 8:	Your level of social support from friends and family?

Results

The results are summarized in Figures 1-4. The error bars represent the 95% confidence interval of the mean (95%CI). Overlapping bar ranges indicate non-statistically significant difference whereas nonoverlapping bar ranges indicate statistically significant differences (ie, $P < .05$). Wellness scores improved in six out of eight areas including quality of life, mental well-being, physical well-being, emotional well-being, social activity and spiritual well-being; no improvements were noted for level of fatigue and social support from family and friends (Figure 1). Figures 2 and 3 summarize the pre-and post-scores for the fall and spring separately, where differences in wellness scores appear more evident in the spring.

Figure 4 shows that while the pre- and post-changes appear greater in the spring than in the fall, they were not significantly different.

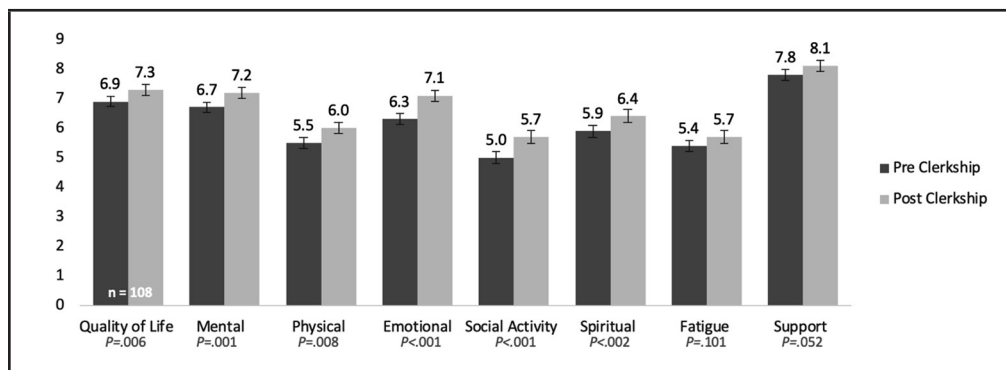


Figure 1. Pre- and Post-Wellness Survey Score Average
 Error bars indicate 95% confidence interval of the mean. Paired t-test used with a one-tailed probability.

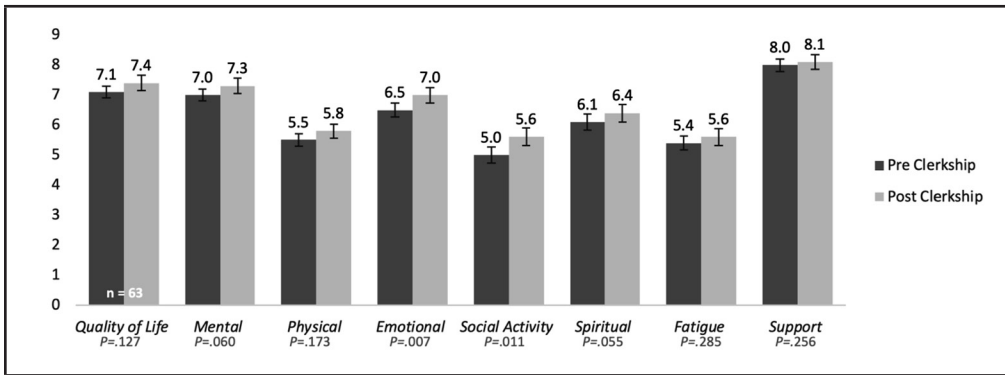


Figure 2. Fall Pre- and Post-Wellness Survey Score Averages

Error bars indicate 95% confidence interval of the mean. Paired t-test used with a one-tailed probability.

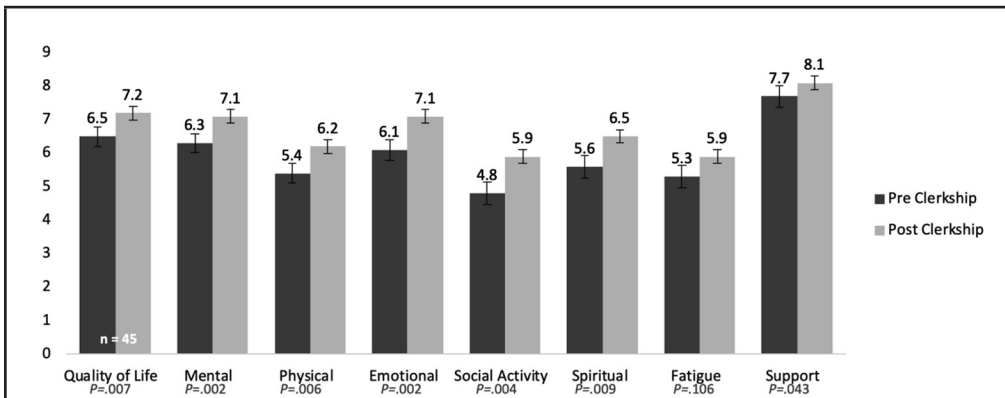


Figure 3. Spring Pre- and Post-Wellness Survey Score Averages

Error bars indicate 95% confidence interval of the mean. Paired t-test used with a one-tailed probability.

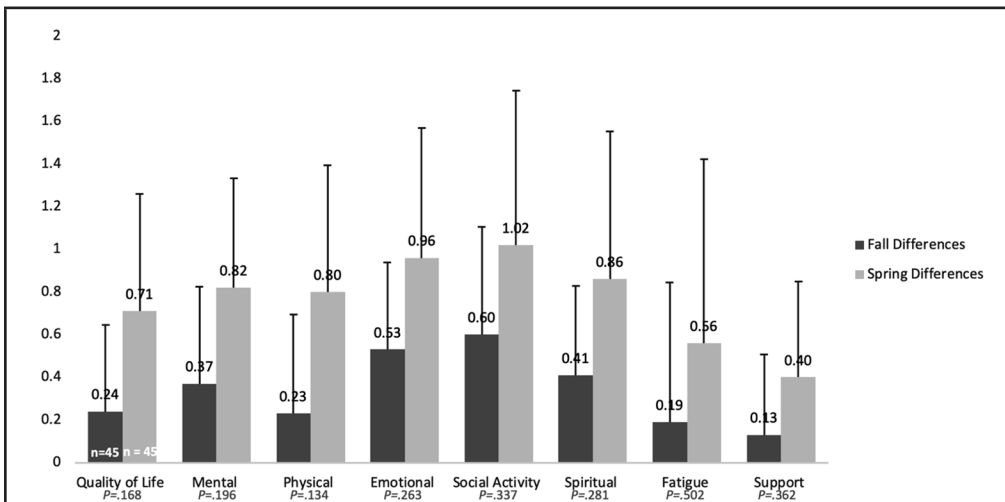


Figure 4. Fall vs Spring Wellness Survey Score Improvements

Error bars indicate 95% confidence interval of the mean. Only the positive bars are shown on this figure. T-tests were used with a two-tailed probability.

Discussion

The wellness program was associated with a small but statistically significant improvement in the participants' overall wellness scores, particularly in mental, physical, emotional, social, and spiritual well-being. It appears that the simple exercises of identifying two wellness goals, and participation in a meditation session and a chair yoga session throughout the 7-week pediatric clerkship improved student wellness by helping students to balance the business of third year medical school responsibilities with their personal wellness. Emotional well-being and social activity showed the highest increases, highlighting the importance of the wellness sessions as a social activity to increase emotional well-being and foster peer relationships. The two values that did not show significant overall improvement were fatigue and social support. This is probably because the curriculum was unable to address the long hours required during the clerkship or medical student's lack of sleep. Furthermore, while only requiring a bit of time, adding this wellness program may have contributed to increased fatigue. The curriculum did not improve social support because the intervention did not specifically target the family and friends who support medical students. In the future, more focus could be made on social support, especially since it has been shown to decrease medical student burnout.⁹

The pre- and post-clerkship scores of students that completed their pediatric clerkship in the fall were compared to those who completed it in the spring. Students generally started at a lower average in each category in the spring compared to the fall. This could be attributed to burnout over the course of the third year, causing students to have overall lower wellness scores in the latter half compared to the beginning. The study also found that there were more categories that increased significantly in the spring (7 of 8) compared to fall (2 of 8). This suggests that the intervention had a greater efficacy in the spring. However, when evaluating this difference between the fall and spring, these differences were not statistically significant (Figure 4). Power testing gave values between 0.10 and 0.30, which shows that the sample size was insufficient to draw any valid conclusions.

Nearly 200 students completed the pre-survey, but only 108 students completed both the pre- and post-curriculum surveys. The poor response rate may have been related to the collection method where only a single request to complete the survey was sent to students, in order to avoid increasing their workload burden. The study may contain some selection bias because of the possibility that those completing the survey might be more positively affected by the wellness program, and hence more likely to complete the second survey. This study lacked a control group since the research team did not want to limit access of our wellness curriculum to the medical students.

Few studies exist on improving student wellness during the clerkship years of medical school. Chung, et al, examined the effect of implementing a mindfulness curriculum during a fourth-year emergency medicine clerkship.¹⁴ Students participated in 4, 1-hour weekly mindfulness sessions with supplemental reading and video assignments, individual meditation practice, and development of a personalized wellness plan with a mentor. Results showed that students who meditated more often during the intervention were more likely to meditate than other medical students, even 6 months after the intervention. The main limitations of their study was the small sample size ($n = 20$), the fact that positive improvements were limited to practicing meditation, and that changes in burnout after the intervention were not measured. Another study by the University of Hawai'i John A. Burns School of Medicine in 2003 implemented interventions among third-year medical students such as individual counseling, faculty education on how to address student stress and burnout, and a personalized student wellness handbook.⁴ That study showed a significant decrease in the number of students reporting depression and suicidal ideation post-intervention. Their study focused on depression and suicidal ideation in students rather than wellness during their clerkships.

This study is the first to show positive improvements in wellness scores by employing simple wellness techniques during the clerkship years. The wellness curriculum involves short interventions requiring minimal resources, making it easy to administer. Since positive improvement in wellness scores was shown during the pediatric clerkship, the next step might be to employ wellness interventions across all clerkships. If students continue to have improvements in their wellness scores in multiple clerkships, a wellness curriculum sustained throughout the third year and beyond could maximize the benefit to students. In addition, further studies could modify the curriculum to address fatigue and social support. They could also potentially include wider interventions in the spring semester to address higher levels of burnout.

Overall, the study was a simple, efficient intervention that was associated with improvements in wellness scores of third year medical students during their pediatric clerkship rotations. This is one of a few studies that describes a wellness curriculum during the clerkship years of medical school. Further expansion of a wellness curriculum to all clerkships during the entire third and fourth years may result in reduced burnout and greater long-lasting improvements in wellness into the post graduate training years and conceivably into practice.

Conflict of Interest

None of the authors identified any conflicts of interest.

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The State of Pediatric Research in Hawai'i: A Comparative Bibliometric Analysis

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Abstract

The current state of pediatric research in Hawai'i was analyzed using bibliometric methods. The Web of Science bibliometric database was used to retrieve 989 Hawai'i records, which were compared with 264 064 records from the United States (US). Hawai'i was compared to the country as a whole in terms of total output of research, article types, top journals, co-authorship, and subject areas. The research was also analyzed in 2 time periods, 1980–1999 and 2000–2019. It was found that the total Hawai'i pediatric research output has not kept pace with the US output. However, it was found that Hawai'i had a greater share of Asia-Pacific co-authorship. Subspecialty areas of study also differed between Hawai'i and the US, and have changed over time from a predominance of infectious diseases and immunology research to a focus on emergency medicine and orthopedics. Neonatology research has increased locally as it has nationally. Hawai'i authors tend to publish a greater percentage of full-length original research articles in the top pediatric journals compared to US authors as a whole. The set of institutions publishing pediatric research in Hawai'i has diversified over time. This analysis of the pediatric research in Hawai'i can be used by researchers, funders, and policy makers to direct future research efforts to improve the health of children in Hawai'i.

Keywords

Bibliometrics, Hawai'i, pediatrics

Introduction

In the last 40 years, there have been many groundbreaking advances in child health including immunizations that prevent meningitis, neonatal care that saves premature babies, and life-saving advances in oncology treatments. None of this would be possible without pediatric research and the funding that drives it. Consequently, understanding pediatric research itself, the corpus of knowledge produced by researchers and physicians, is also an important undertaking. It can provide stakeholders with information that can further advance pediatric research and child health.

Understanding research at a state level is also critical especially if the children in that state may not be well represented by research produced on a national or global scale, or if different diseases may be more common in one state compared to another, as seen with some infectious diseases. Arguably, both of these statements are true in the state of Hawai'i where the demographics and some of the tropical diseases which occur are different than the continental US. Understanding pediatric research in Hawai'i is, therefore, not only an interesting endeavor, but one that can further advance the health of children in Hawai'i. This study takes a bibliometric approach and describes

the current state of published pediatric literature produced by Hawai'i authors, compared both to earlier time periods and to the US more broadly.

Bibliometrics is the application of mathematical and statistical methods to books and other communications, including journal articles.¹ It has been used across science and medicine, including the field of pediatrics. Recently, Quinn, et al, published in *Pediatrics* a bibliometric analysis of the top 100 cited articles in pediatrics since 1945 and also explored trends in the pediatric literature.² A similar effort was published by Chhapola, et al, looking at journals, authors, and disciplines among the top 100 cited articles in pediatrics.³ These previous works looked at citation classics across the field, but did not provide a detailed view of the pediatric literature in particular regions. This study aims to fill that gap with a focus on Hawai'i's pediatric literature with the aim of providing insights into the strengths and challenges of Hawai'i's pediatric research community.

Instead of focusing on a randomly chosen number of “top-cited articles” the focus of this study was on trends over time to answer the question of what the current state of Hawai'i literature is compared to the recent past. It was hypothesized that Hawai'i's research in pediatrics would generally mirror the US output in terms of the trends over time as well as in the types of articles that were being published. However, it was also hypothesized that Hawai'i would have a larger share of Asia-Pacific pediatric research, compared to the US in general, given our geography in the Pacific Ocean. And finally, it was hypothesized that due to the unique population of Hawai'i's children compared to the US census as well as the role Hawai'i plays in global tourism, there would be differences in the subspecialty areas of research study as compared to the US as a whole.

This study may prove to be of importance to local research funding organizations and policy makers who wish to rectify gaps in the local research coverage, identify means of supporting additional scholarship, or explore avenues of future research for which there may be an unexplored niche.

Methods

Hawai'i Pediatric Research Dataset

Records were retrieved from Clarivate Analytics Web of Science bibliographic database published between 1980 and 2019. All records with an author affiliation with the state “HI”, and in a

journal with a Web of Science Subject Category of “pediatrics”, were retrieved. A total of 989 records were analyzed. This dataset was split into 2 time periods, 1980–1999 and 2000–2019, with 407 records and 582 records in each group, respectively.

US Pediatric Research Dataset

Records were retrieved from Clarivate Analytics Web of Science bibliographic database published between 1980 and 2019. All records with author affiliation with the country “USA” and in a journal with a Web of Science Subject Category of “pediatrics” were retrieved. A total of 264 064 records were analyzed. This dataset was split into 2 time periods, 1980–1999 and 2000–2019, with 98 577 and 165 487 records in each group respectively.

Data Analysis

For all datasets and time periods, the data fields for subject category, journal, document type, and author country affiliation were analyzed. Subject category labels were taken from the Web of Science Subject Categories assigned to journals in Clarivate’s Web of Science database. Top journals were based on the total number of records in each journal name. Document type was drawn from Web of Science’s type field, with the article type defined as “Reports of research on original works.” For comparisons across multiple categories, the top 5 highest categories in each region and time period were used, and the binary log ratios of the proportions were calculated as US proportion compared to Hawai‘i proportion, such that a value of “1” indicates that the US proportion is twice that of Hawai‘i, and “-1” indicates that the Hawai‘i value is twice that of the US. Journal names were checked for name changes in Web of Science and where applicable, the documents for such journals were combined. For author country analysis, all countries other than the US were defined as international, and all countries with names categorized in the United Nations geographic regions of East Asia, Southeast Asia, and Oceania were categorized as Asia-Pacific.⁴

Institutions were drawn from the Web of Science author organization field and Hawai‘i-based institutions were manually identified and name variations were combined. Institutions with low counts were combined into private, non-profit, and community health center categories based on comparison with publicly available information.

Results

Growth of Hawai‘i Pediatric Research Over Time

The number of pediatric documents in Web of Science published each year between 1980 and 2019 with either Hawai‘i or US authors is shown in Figure 1. There is a general trend of increasing publications over time in both groups, with adjustments on shorter timescales seen in years such as 2001 and 2004. Hawai‘i

pediatric publications tracks the US pattern closely until around 2010, when the US pediatric research output continues to increase while Hawai‘i pediatric publications remain relatively steady. The same general trend, but with a smaller degree of difference, is seen when examining only the full-length research articles in each region. Examining the change in the average number of items by decade, the US increases by 60% and 51% of total records and articles respectively from 2000–2009 to 2010–2019, while Hawai‘i increases by 4% and 36% in the same categories and time periods.

Publication Types of Hawai‘i Pediatric Research

The document types of Hawai‘i and US pediatric research are compared in Figure 2. Documents in Web of Science are classified as number of types, but this study examined those classified as full-length research articles, the other types being documents such as news, letters, editorials, or reviews. As shown in Figure 2, both Hawai‘i and US pediatric research was comprised of about 50% articles in the 1980–1999 period. This increased in both regions in the 2000–2019 period, but the proportion of Hawai‘i pediatric research articles increased to a greater extent, to 68.7% compared to 58% in the US.

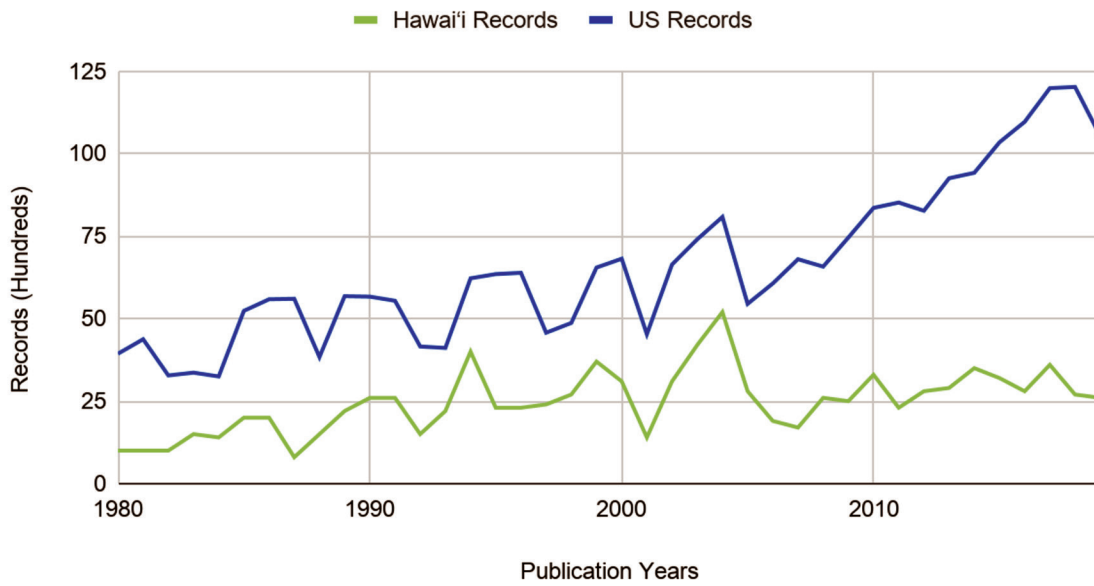
Journals by Publication Count in Hawai‘i Pediatric Research

The 5 journals with the highest proportion and counts of documents in each region and time period are shown in Table 1. Since the same journal could appear in more than one period, this table includes 10 journals in total. The combined proportion of the 5 journals with the highest record counts in each region and time period is shown in Figure 3. There is a clear trend in both regions towards increased diversity of publications outside of a few journals over time, with Hawai‘i showing more diversity than the US in the 2000–2019 time period. It is important to note that these are the highest journals by publication count, and that this study did not look at citation counts or journal impact factors, which is another method of ranking top journals, but was not used here.

Subject Categories of Hawai‘i Pediatric Research

The subject categories that most commonly appear with pediatric research was next analyzed. The proportions and counts of each of the top 5 subject categories (a total of 11 unique subjects) from the 4 different groups are shown in Table 2. The log ratio comparisons of the early (top) and late (bottom) periods are shown in Figure 4. There is a clear change in research subjects in Hawai‘i between the early and late periods from a focus on immunology and infectious diseases in the 1980-1999 period to a focus on orthopedics and emergency medicine in the 2000–2019 period. There are other trends in the US subjects, such as increasing research in oncology and obstetrics and gynecology that are also reflected in the Hawai‘i research.

(a) Hawai'i Records and US Records



(b) Hawai'i Articles and US Articles

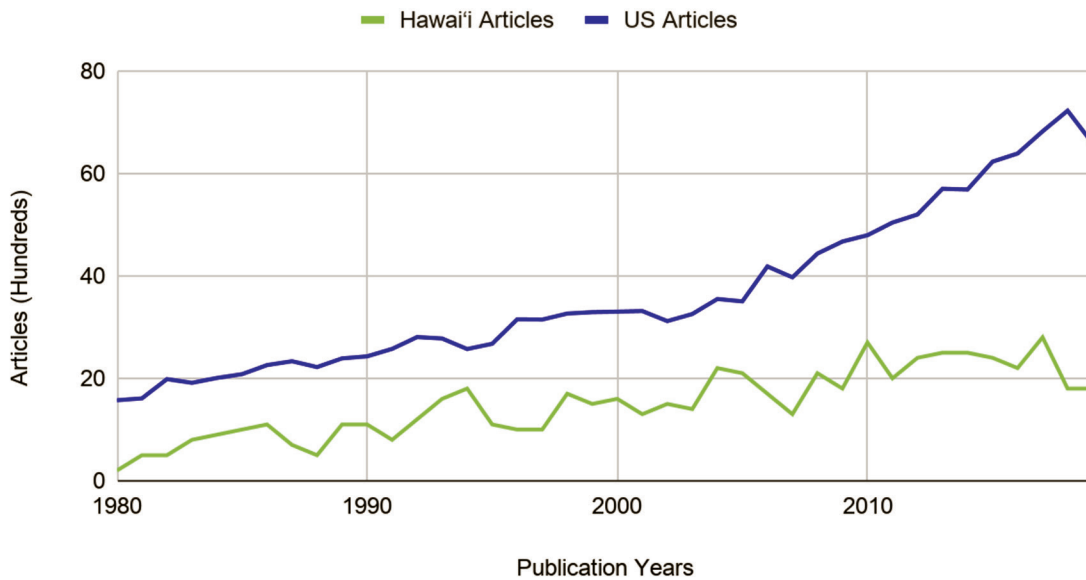


Figure 1. Number of Pediatric Journal Records and Full-Length Articles Published in the Web of Science –Hawai'i and the US, 1980–2019
The figure shows the number of pediatric journal records (a) and full-length articles (b) published in Web of Science over time, comparing those with Hawai'i authors to those with US authors.

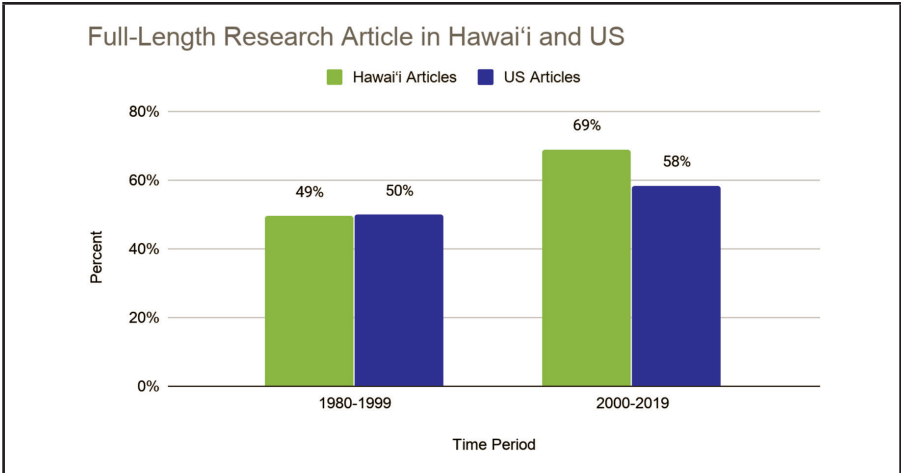


Figure 2. Full-Length Research Articles in the Web of Science – Hawai'i and the US, 1980–2019
 The figure shows a comparison of the number of records in Web of Science with the article document type, which denotes a full-length research article as opposed to review or editorial material. The percentage of total records is shown in the vertical axis, and 2 time periods are compared, 1980–1999 and 2000–2019 for both Hawai'i and US authorships.

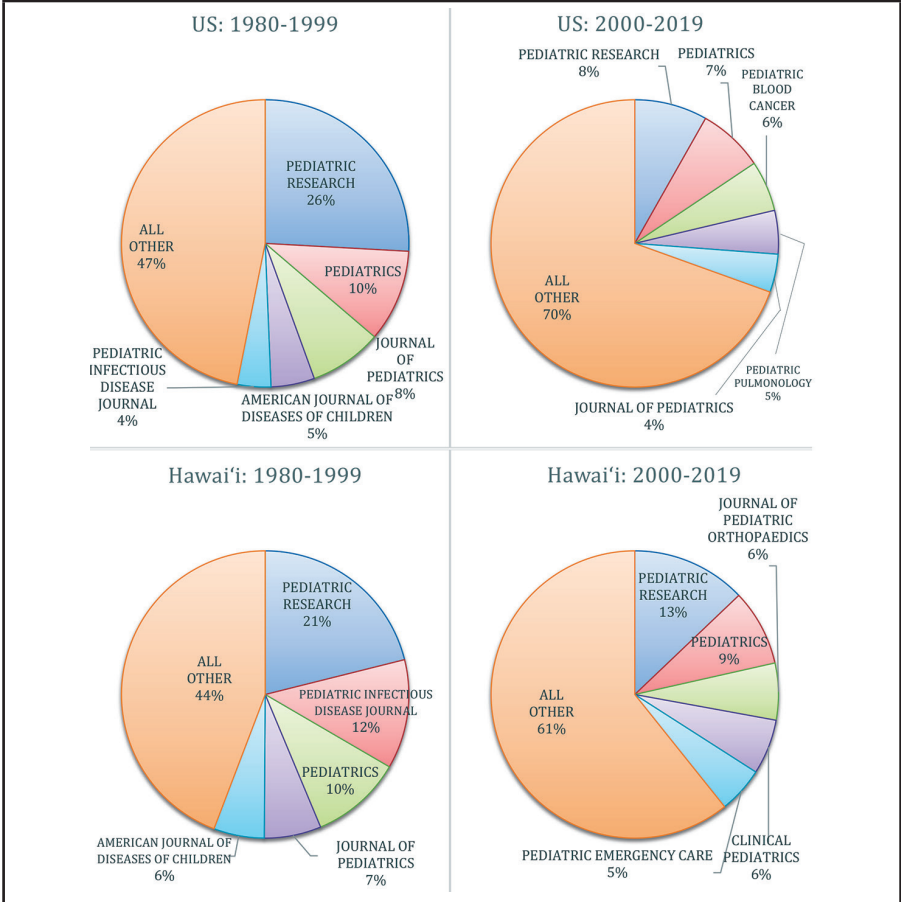


Figure 3. Five Most Published Journals in Each Time Period and Region – Hawai'i and the US, 1980–1999 and 2000–2019
 This figure shows the distribution of the 5 journals with the highest number of published records from each time period in the US and Hawai'i.

Table 1. Pediatric Research Journals in Hawai'i and the US, 1980–1999 and 2000–2019 ^a				
Journal ^b	Hawai'i 1980–1999 % (Records)	Hawai'i 2000–2019 % (Records)	US 1980–1999 % (Records)	US 2000–2019 % (Records)
Pediatric Research	21.1 (86)	12.9 (75)	25.9 (25502)	8.2 (13515)
Pediatrics	10.3 (42)	8.6 (50)	10.4 (10206)	7.4 (12176)
Journal of Pediatrics	6.4 (26)	4.8 (28)	8.2 (8109)	4.3 (7162)
American Journal Of Diseases Of Children (JAMA Pediatrics)	5.7 (23)	2.9 (17)	4.9 (4788)	1.5 (2487)
Pediatric Infectious Disease Journal	12.3 (50)	3.1 (18)	3.8 (3715)	2.1 (3466)
Pediatric Blood Cancer (Medical And Pediatric Oncology)	2.2 (9)	3.3 (19)	1.5 (1450)	5.7 (9468)
Pediatric Pulmonology	2.5 (9)	1.0 (6)	1.0 (962)	4.9 (8190)
Journal of Pediatric Orthopaedics	3.4 (14)	6.4 (37)	1.6 (1557)	1.5 (2555)
Clinical Pediatrics	4.2 (17)	6.2 (36)	2.5 (2434)	1.9 (3183)
Pediatric Emergency Care	1.2 (5)	5.2 (30)	0.8 (774)	1.8 (3051)
All Other Journals	30.7 (126)	45.7 (266)	39.6 (39080)	60.6 (100234)

^a US Numbers indicate the percentage (%) of the total number of records in that time period for that group.

^b The journals listed in this table were chosen for being in the top 5 journals by proportion for each of the 4 groups. Journals with name changes over time were identified manually and their values combined.

Table 2. Most Common Web of Science Subject Categories in Hawai'i and the US, 1980–1999 and 2000–2019 ^a				
Subject Category ^b	Hawai'i 1980–1999 % (Records)	Hawai'i 2000–2019 % (Records)	US 1980–1999 % (Records)	US 2000–2019 % (Records)
Psychology developmental	9.3 (38)	7.0 (41)	8.6 (8517)	8.1 (13429)
Surgery	2.5 (10)	5.2 (30)	4.6 (4500)	5.6 (9246)
Obstetrics gynecology	3.2 (13)	7.6 (44)	4.4 (4323)	6.9 (11431)
Psychiatry	6.1 (25)	4.1 (24)	4.4 (4310)	4.1 (6723)
Clinical neurology	1.2 (5)	1.7 (10)	4.1 (4053)	6.1 (10012)
Oncology	2.9 (12)	5.0 (29)	2.9 (2836)	7.2 (11862)
Hematology	0.7 (3)	4.6 (27)	1.4 (1386)	7.0 (11590)
Immunology	12.3 (50)	3.1 (18)	4.0 (3948)	2.4 (4020)
Infectious diseases	12.3 (50)	3.3 (19)	3.9 (3877)	2.4 (4024)
Orthopedics	3.4 (14)	7.4 (43)	1.6 (1605)	1.9 (3083)
Emergency medicine	1.2 (5)	5.2 (30)	0.8 (774)	1.8 (3051)

^a Values represent the percentage (%) of records in that group that are labeled with the specific subject category.

^b The 11 subject categories are included based on being in the top 5 categories of the groups.

Subject Ratios: US/Hawai'i

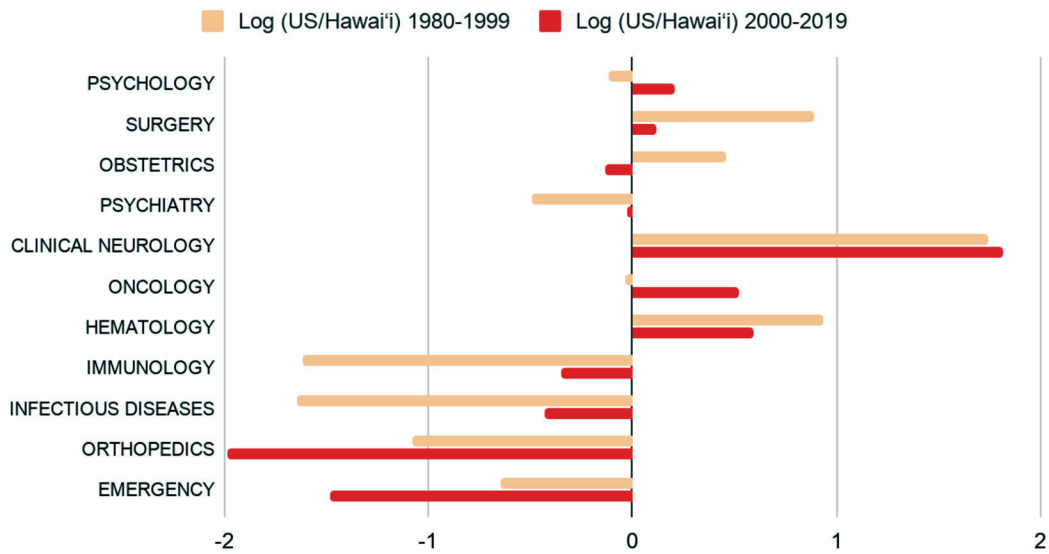


Figure 4. Relative Ratio of Web of Science Subject Categories Published by Authors in Hawai'i and the US, 1980–1999 and 2000–2019
 The figure shows the relative ratio of Web of Science Subject Categories comparing records published by US versus Hawai'i authors in 1980–1999 and 2000–2019. The binary log ratio is shown between the percentage of each subject area, where “1” indicates that the US percentage is twice the Hawai'i percentage and “-1” indicates the opposite.

Country Co-authorship Ratios: US/Hawai'i

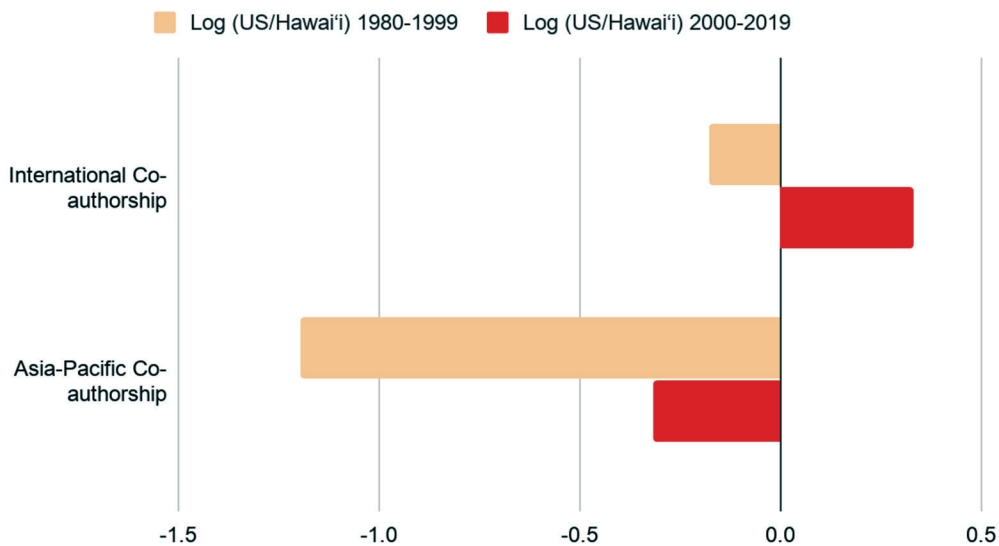


Figure 5. Relative Ratio of International and Asia-Pacific Co-authorship in Pediatric Journal Records – Hawai'i and the US, 1980–1999 and 2000–2019
 The figure shows the relative ratio of international and Asia-Pacific co-authorship in pediatric records from Hawai'i and the US in 1980-1999 and 2000-2019. The binary log ratio is plotted, where a value of “1” indicates twice the percentage of US records in that time period, and a value of “-1” indicates twice the percentage of Hawai'i records compared to US.

Type of co-authorship	Hawai'i 1980–1999 % (Records)	Hawai'i 2000–2019 % (Records)	US 1980–1999 % (Records)	US 2000–2019 % (Records)
International ^a	6.9 (28)	18.4 (107)	6.1 (6013)	23.2 (38393)
Asia-Pacific ^b	1.7 (7)	5.0 (26)	0.8 (788)	4.0 (6619)

^a International records contained at least 1 co-author from a country other than the US.

^b Asia-Pacific records contained at least 1 co-author from a country listed in the United Nations subregions of East Asia, Southeast Asia, or Oceania.

Hawai'i organization	1980-1999 Records		2000-2019 Records	
	n	% ^a	n	% ^a
University of Hawai'i	217	53.3	365	62.5
Tripler Army Medical Center	179	44.0	122	20.9
Kapi'olani Medical Center for Women and Children ^b	57	14.0	102	17.5
Shriners Hospital for Children-Honolulu	11	2.7	23	3.9
Kaiser Permanente Hawai'i	11	2.7	21	3.6
The Queen's Medical Center	5	1.2	5	0.9
Hawai'i State Department of Health	4	1.0	37	6.3
Straub Medical Center*	2	0.5	0	0.0
Kuakini Medical Center	0	0.0	3	0.5
Hawai'i Department of Education	0	0.0	4	0.7
Hawai'i Medical Service Association	0	0.0	1	0.2
Hawai'i Pacific University	0	0.0	1	0.2
Hawai'i Residency Program	0	0.0	2	0.3
Small Non-Profit	0	0.0	21	3.6
Private Organizations	0	0.0	11	1.9
Community Health Centers	2	0.5	7	1.2

^a The columns with the percentages (%) of records do not add to 100% as records can occur in more than 1 category due to co-authorship.

^b Kapi'olani Medical Center for Women and Children and Straub Medical Center are noted as being part of the Hawai'i Pacific Health organization starting in 2001, and all records from those institutions are grouped with Kapi'olani Medical Center for Women and Children in the 2000–2019 dataset.

International Authorship of Hawai'i Pediatric Research

To test the hypothesis that Hawai'i, due to its unique geographical and cultural position in the center of the Pacific, would exhibit increased international and Asia-Pacific collaboration in pediatric research, the co-author affiliations were analyzed. The proportion and counts of documents that have either international or Asia-Pacific co-authors are shown in Table 3. There is a trend towards increasing international authorship from 1980–1999 to 2000–2019 that is seen in both Hawai'i and the US. In both periods, Hawai'i pediatrics research has a higher level of Asia-Pacific co-authorship. Figure 5 shows the log ratio comparison, showing that while the levels of international co-authorship are relatively similar for the US and Hawai'i, Asia-Pacific co-authorship is greater in Hawai'i pediatric research, though it is decreasing over time.

Institutional Affiliations of Hawai'i Pediatric Research

The organizations identified with Hawai'i pediatric records in each time period are shown in Table 4. There is an increase in the number of institutions found publishing in the later time period. Small private and non-profit institutions that were not seen in the 1980–1999 dataset make up a larger proportion of the 2000–2019 dataset. The proportion of records from the University of Hawai'i, which includes the John A. Burns School of Medicine, is also increasing. The Web of Science data does not distinguish reliably between departments within a single university, so the data looking for trends within the University of Hawai'i was not available.

Discussion

This study set out to map the state of pediatric research in Hawai‘i, both currently and in the past and, in comparison, to the rest of the US. This was accomplished by analyzing trends in publication counts, journals, disciplinary subjects, document types, and author affiliation countries. Overall, this descriptive contribution should be useful to researchers and policymakers in Hawai‘i and elsewhere to better guide research efforts. Some specific findings are highlighted below.

One finding of this study was the observation that Hawai‘i research mirrored the growth of pediatric research in the US remarkably closely until 2010 when the US publications increased more dramatically and Hawai‘i’s output leveled off. This could reflect the well-known and grave problem in Hawai‘i of a growing physician shortage.⁵ Physicians who conduct research are often practicing physicians and with this physician shortage in Hawai‘i, there may be less time dedicated for research than the greater US.

Trends in research may also be attributed to differences in funding, although a comparison of funding between the US and Hawai‘i was beyond the scope of this bibliometric analysis. However, a recent publication in *JAMA Open Network* analyzed research on Asian American, Native Hawaiian, and Pacific Islander (AA/NHPI) populations and found that “proportional increases in research dollars for AA/NHPI clinical research were not consistent with increases in the overall NIH [National Institute of Health] research budget, suggesting that underrepresentation of AA/NHPI research subgroups may be partially responsible.”⁶ Given that Hawai‘i’s population is 57.2% Asian and 26.9% Native Hawaiian and Pacific Islander, this finding could significantly impact the research output in Hawai‘i as compared to the US.⁷

Another difference between Hawai‘i and the US is in publication type. Hawai‘i authors are focused on publishing research articles rather than news, letters, editorials, or reviews as compared to the US. There has been a proliferation of new journals in recent years, and Hawai‘i publications make use of this diversity. This may also result in less research output, if Hawai‘i researchers are focused on full-length original research manuscripts in top journals.

Another finding of further interest is the focus of research in Hawai‘i, different than the US, and has changed over time. The predominance of infectious diseases and immunology articles in the 1980s to 2000 is thought provoking. This focus may reflect a combination of various factors, including the availability of productive and prolific researchers, epidemiological disease trends of local infectious diseases, and/or the effect of a local niche of studying diseases that affect AA/NHPI populations such as Kawasaki disease or rheumatic fever.^{8,9}

The more recent local focus on orthopedics and emergency medicine research is also of interest. Again, the presence of prolific researchers may in part be responsible. This shift may also represent the unique geography of Hawai‘i as an island state, with interest in emergency topics such as drownings or other marine-related injuries.¹⁰

In Web of Science, the pediatric subspecialty of neonatology falls under the “obstetrics and gynecology” subheadings due to publications in perinatal journals. In Hawai‘i and in the US, neonatology research has increased. The paper by Quinn, et al, on the top 100 cited articles in pediatrics identified neonatology as the second most cited subspecialty. This likely reflects this field’s recent development, proliferation, and technological advances, with modern neonatology evolving rapidly from the 1960s, as compared to the historical development of other pediatric subspecialties.¹¹

International co-authorship was used as an indicator of global research impact in this study. It was found that collaborations with global partners between US and Hawai‘i authors has increased over time. Indeed, the hypothesis that Hawai‘i has a unique connection to the Asia-Pacific region was confirmed. This is a notable finding given the state university’s stated mission “with its unique geographic location bridging East and West, Mānoa serves as a portal to an exceptional educational experience while striving to improve quality of life in the region through collaborative partnerships that support innovations in education, health care, social development, culture and arts, earth, space, and ocean sciences, sustainable land management, and technological advancement.”¹² Additionally, the state medical school’s mission “to teach and train high-quality physicians, biomedical scientists, and allied health workers for Hawai‘i and the Pacific.”¹³ Arguably, these missions are being met.^{12,13}

Hawai‘i authors institutional affiliations were analyzed to determine the origins of Hawai‘i research papers. The majority of authors listed their affiliation with the University of Hawai‘i. Limitations of Web of Science data prevent further breakdown of author affiliations into departments, schools, or centers of origin. Author affiliation with Tripler Army Medical Center was the next highest institution, though this has decreased from the pre-2000 era. Over the years of the study, institutions also changed. Thus, in the later dataset, Hawai‘i Pacific Health is listed by some authors while other authors chose to cite its affiliated medical centers, such as Kapi‘olani Medical Center for Women and Children or Straub Medical Center. To be sure, Hawai‘i Pacific Health is the parent entity for both Kapi‘olani and Straub. Further, it is interesting to note that 86% of all Hawai‘i Pacific Health records were affiliated with Kapi‘olani. Non-profit research entities have emerged in the dataset after 2000, but overall comprise a small proportion of author affiliations. This is also true of several for-profit entities, such as private subspecialty offices. The state’s health department has

also become a common author affiliation designation in the later dataset. Finally, there was only 1 record of author affiliation with a university other than the University of Hawai‘i (ie, Hawai‘i Pacific University).

While this study’s methodology would be inappropriate for evaluative purposes, the data may be of value to policy makers and research funding institutions to better understand the origins, trends, affiliations, and focus of research activities in Hawai‘i. It may also serve to invigorate research collaborations and partnerships, as researchers recognize the broader landscape of pediatric research in Hawai‘i as well as the identify of potential collaborators.

The limitations of this study include the analysis of international impact, which was based entirely on the identification of co-authorship. A citation analysis was not performed. This could be the focus of a later study, involving a random sample of the 264 064 US pediatric articles and comparing them to Hawai‘i data. Additionally, subject categories in the Web of Science do not allow for further delineation of research areas that may be critical to fully understanding local research. For instance, to better understand trends in infectious diseases research, it would be important to identify which conditions, such as angiostrongyliasis, leptospirosis, or Kawasaki disease are being studied. As such, a future study could be performed utilizing corpus analysis to compare the frequency of terms used in one body of research with another. Another limitation of bibliometrics research is that it looks only at published literature. A deeper understanding of pediatric research in Hawai‘i may result from interviews and surveys of the physician scientists. This could be an avenue of future research. The bibliometric methods of the study could also be expanded, for example, by considering citations in the analysis of top journals and articles. Finally, the author affiliation analysis could be more robust if each individual paper were obtained and a more granular author affiliation was identified (eg, by department within John A. Burns School of Medicine).

Finally, a recommendation from this study is to support the exploration and expansion of future funding for pediatric research in Hawai‘i, especially focused on the AA/NHPI population, appreciating the importance of addressing health disparities in these vulnerable populations. Other medical disciplines in Hawai‘i and other states in the US may benefit from similar analyses to broaden their understanding of the research landscape in their areas.

Conflict of Interest

None of the authors identify any conflict of interest.

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Disseminated Cat Scratch Disease in Pediatric Patients in Hawai'i

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Abstract

Cat scratch disease is known to be a generally benign, self-resolving illness associated with non-specific symptoms, including lymphadenopathy, fever, fatigue, anorexia, and headaches. However, it can also cause disseminated disease with a wide range of manifestations, including liver and spleen microabscesses, osteomyelitis, encephalitis, and uveitis. Eighteen pediatric cases of disseminated cat scratch disease at a single center in Hawai'i are described. This case series emphasizes the importance of disease recognition and use of appropriate diagnostic tools and disease management. The disease burden of pediatric patients with disseminated cat scratch disease in the state of Hawai'i has a high incidence and should be considered in pediatric patients with prolonged febrile illnesses.

Keywords

Bartonella henselae, diagnosis, disseminated cat scratch disease, pediatrics, treatment

Abbreviations

CSD = cat scratch disease
CT = computed tomography
ESR = erythrocyte sedimentation rate
IgG = immunoglobulin G
IgM = immunoglobulin M
KMCWC = Kapi'olani Medical Center for Women & Children
MRI = magnetic resonance imaging
PCR = polymerase chain reaction
TMP-SMX = trimethoprim-sulfamethoxazole

Introduction

Cat scratch disease (CSD) is caused by the gram-negative bacterium *Bartonella*, most commonly *B. henselae*. The primary carriers are cats, who can remain bacteremic for months. Cat-to-cat transmission occurs via fleas, with the organism most frequently transferred to humans via a cat scratch or bite. In most cases, the disease is benign and self-resolving with nonspecific symptoms, including lymphadenopathy (for weeks to months), fever, fatigue, abdominal pain, anorexia, and headaches.¹ However, disseminated CSD, which involves more than lymphadenopathy alone, can occur with wide-ranging manifestations from liver and spleen microabscesses to encephalitis.

B. henselae is endemic to warm, humid climates with studies showing higher incidences in the southern states and California. Despite the warm tropical climate, prior studies have not highlighted the incidence of disseminated CSD in Hawai'i. Nelson and colleagues reported less than 10 cases of CSD in Hawai'i over an 8-year period, likely a considerable underestimate given

that this included both typical CSD and disseminated cases.² This case series demonstrates the high incidence of *B. henselae* in Hawai'i and describes one of the largest cohorts of disseminated CSD in the current literature. Furthermore, it reviews antibiotic treatment, duration of treatment, and outcomes measurements in these patients to gain a better understanding of the treatment options and to propose potential antibiotic regimens.

Patients and Methods

This series was a retrospective chart review of patients (children aged 18 or younger at time of admission) diagnosed with CSD at Kapi'olani Medical Center for Women and Children (KMCWC) in Honolulu, Hawai'i, between 2009 and 2018. KMCWC is a tertiary care medical center and the only children's hospital in the state of Hawai'i. Patient medical records from both inpatient and emergency department settings were reviewed using *International Classification of Diseases and Related Health Problems, Ninth Edition (ICD-9)* and *International Classification of Diseases and Related Health Problems, Tenth Edition (ICD-10)* codes corresponding to CSD, Bartonellosis, liver abscess, spleen abscess, fever of unknown origin, and vertebral osteomyelitis. Cases were then narrowed and verified based on radiologic and lab documentation suggestive of CSD (ie, *B. henselae* polymerase chain reaction [PCR], serology, or imaging indicative of microabscesses or osteomyelitis). Microabscesses in the liver and spleen were described as "hypoechoic" on ultrasonography or "hypodense" on computed tomography (CT) while both "lytic" lesions and marrow enhancement were interpreted as indicative of osteomyelitis on magnetic resonance imaging (MRI) or CT scans. Disseminated CSD was defined as clinical or radiographic evidence of illness involvement beyond that of just lymphadenopathy. Demographic data and the following items were collected from the chart reviews: diagnostic labs and imaging, antibiotic choice and treatment duration, symptom duration, and follow-up studies. Insurance type was used as a surrogate marker for socioeconomic status. This study was considered exempt from review by the Hawai'i Pacific Health Institutional Review Board (No. 2017-029).

Results

A total of 25 children diagnosed with CSD were identified, 4 were excluded due to incomplete workup. This study reviewed the 18 disseminated CSD cases, 16 of which were hospitalized with 1 patient readmitted after an initial discharge due to persistence of fever.

In the study population, there was a nearly equal gender predilection with 44% male, whereas prior studies had shown a male predilection. Patient demographic and clinical features are displayed in Table 1. Fifteen of the 16 admitted patients reported fever prior to admission; the overall median fever duration was 19 days (range, 3-35 days). Three of the hospitalized disseminated CSD patients had no fever while hospitalized. Median length of hospitalization was 8.5 days (range, 0-15 days). Only 7 cases (39%) had reported or documented lymphadenopathy. Excluding the 1 patient who was readmitted for recurrence of fevers, 12 patients had their fever subside during their hospital stay, ranging from 1 to 11 days into CSD treatment (median, 4 days). Median white blood cell count on presentation was 11.5 (range, 6.7-20.2), with only 2 patients having an elevated white blood cell count. Elevated C-reactive protein and erythrocyte sedimentation rate (ESR) were common but were non-specific, and their elevation did not appear to correlate with disease severity or category. Radiologic studies consisted of ultrasound and CT with 16 patients having an abdominal ultrasound performed, 9 patients underwent abdominal CT, and 8 patients undergoing both as seen in Table 2. In 2 cases, the ultrasound was negative for liver or spleen microabscesses while CT was positive. In 1 case, the CT was negative for microabscesses, but the ultrasound was positive. There was a varied seasonal distribution of disseminated CSD with a peak in the months of February, July, September, and October with 3 cases (17%) in each month. Of the 18 patients, 13 patients had liver or splenic lesions, 4 had

osteomyelitis (2 vertebrae, 1 sacrum/iliac, and 1 rib), 1 had uveitis, and 2 had encephalitis. Of the 4 osteomyelitis cases, 1 was diagnosed incidentally via CT of the abdomen and the remainder noted on MRI. The mean patient age was 8.0 years (range, 1 to 15 years; standard deviation, 3.7) with all patients describing prior cat exposure.

None of the *B. henselae* PCR of the blood samples were positive, however, of the disseminated cases, there were positive PCR results for 1 tissue biopsy and 1 lymph node aspirate. Serologic tests were available for 16 cases, 3 of which had initial negative IgM on admission. When comparing day of illness versus IgM titers (Figure 1), IgM often became positive by day 11 and negative by day 40. Eighty-one percent of cases were positive for both *B. henselae* IgG and IgM.

The concurrent workup of patients until CSD was confirmed was extensive, with blood culture, Epstein-Barr virus and Cytomegalovirus serology, and echocardiogram being some of the most frequently ordered tests for patients. Combination therapy was used in all cases, except 2 cases of azithromycin monotherapy with subsequent resolution of fever. The most commonly prescribed combinations were azithromycin and rifampin (8 of 18), or azithromycin, gentamicin, and rifampin (4 of 18) (Table 3). One case of confirmed uveitis was treated with azithromycin, rifampin, and prednisolone as an outpatient. Out of 18 disseminated cases, 5 were lost to follow-up.

Table 1. Demographic and Clinical Features of the Eighteen Children with Disseminated Cat Scratch Disease^a

Patient number	Sex/Age	Presenting Clinical Symptoms			
		Duration of fever (d)	Fever ^b	Abdominal pain ^b	Other
1	F/5y	15	(+)	(+)	Headache, diarrhea
2	F/4y	NA	(-)	(-)	Inguinal fullness
3	F/15y	35	(+)	(-)	Headache, neck pain, emesis, back pain, body ache, cough, chest pain
4	M/3y	31	(+)	(-)	Diarrhea, emesis, back pain, leg pain
5	F/7y	3	(+)	(-)	Neck swelling
6	M/13y	21	(+)	(-)	Back pain, anorexia, diarrhea, eye irritation, headache
7	M/6y	21	(+)	(+)	Headache, neck pain, muscle cramps, red eyes
8	M/2y	14	(+)	(-)	Eye irritation, diarrhea, fatigue
9	F/4y	24	(+)	(+)	Headache, constipation, anorexia
10	F/10y	13	(+)	(-)	Headache, rhinorrhea, cough, myalgia, anorexia
11	M/21mo	17	(+)	(-)	Fussy, fatigue, anorexia
12	F/5y	13	(+)	(-)	Unilateral eye redness, less active, anorexia
13	F/11y	11	(+)	(+)	Anorexia, fatigue
14	F/13y	22	(+)	(-)	Headache, back pain, hand edema, fatigue, cracked lips
15	M/3y	19	(+)	(-)	Cough, rhinorrhea, less active, anorexia
16	M/10y	14	(+)	(+)	Headache, back pain, weight loss, dizziness, syncope
17	M/15y	NA	(-)	(-)	Altered mental status, seizure
18	F/9y	NA	(-)	(-)	Fatigue, seizure, altered mental status

Abbreviations: d, days; F, female; M, male; mo, month; NA, not applicable; y, year. ^aAll patients had cat or kitten exposure. ^bThe symbols "(+)" means present and "(-)" means absent.

Long-term follow-up was variable. In some cases, imaging studies guided duration of antimicrobial therapy with 2 patients having extended treatment due to positive repeat imaging, and 5 patients having resolution of lesions on imaging at planned

completion of therapy. Repeat imaging was performed in half of the osteomyelitis cases, but did not affect duration of therapy. Six patients had no repeat imaging at follow-up and only 2 out of the 4 osteomyelitis cases had repeat MRI at follow-up.

Patient	Physical examination findings ^a			Abdominal ultrasound lesions in ^a		Abdominal CT lesions ^a		<i>Bartonella henselae</i> ^a	<i>Bartonella henselae</i> serology ^a		Inflammatory marker
	Fever	HSM	Other	Liver	Spleen	Liver	Spleen	PCR	IgM	IgG	Initial CRP
1	(+)	(-)	None	(-)	(+)	(-)	(-)	(-)	1:128	1:1024	18.1
2	(+)	(-)	Left>right groin fullness	(-)	(+)	NA	NA	(-)	NA	NA	5.2
3	(+)	(-)	Murmur, axillary, cervical and inguinal lymphadenopathy	NA	NA	(+)	(+)	NA	1:16	1:2048	NA
4	(+)	(-)	None	(-)	(-)	(+)	(+)	NA	1:128	1:1024	20.6
5	(+)	(-)	Neck mass	(+)	(+)	(-)	(-)	(-) ^b	1:16	1:152	2.8
6	(+)	(-)	Murmur, abdomen tender to palpation, inguinal lymphadenopathy	(-)	(+)	NA	NA	(-)	1:256	1:1024	90.9
7	(+)	(-)	Bilateral conjunctivitis, tender foot nodule	(+)	(-)	(+)	(-)	NA	(+)	(-)	103.6
8	(+)	(-)	LUQ fullness, bilateral conjunctivitis	(-)	(+)	(-)	(-)	(-)	1:40	1:128	81.6
9	(+)	(-)	Murmur	(+)	(+)	(+)	(+)	(-)	NA	NA	127.7
10	(+)	(+)	Forearm papule, axillary lymphadenopathy	(-)	(-)	(+)	(+)	(-)	1:128	1:1024	NA
11	(+)	(-)	None	(+)	(+)	NA	NA	(-)	< 1:16	1:512	NA
12	NA	(-)	Unilateral conjunctivitis, dry lips	(-)	(-)	NA	NA	(-)	1:32	1:128	NA
13	(+)	(+)	Nontender cervical lymphadenopathy	(-)	(-)	(-)	(+)	(-)	< 1:16	1:64	220
14	(+)	(-)	None	(-)	(+)	NA	NA	(-)	1:128	1:1024	6.2
15	(+)	(-)	Indurated swelling over left flank	NA	NA	(+)	(+)	(-) ^b	1:32	1:64	42.1
16	(+)	(+)	Back and right SI joint tenderness to palpation	(-)	(-)	(-)	(+)	(-)	1:256	1:152	21.3
17	(-)	(-)	Left axillary swelling, AMS, seizure	NA	NA	NA	NA	(-)	(-)	1:256	28.1
18	(-)	(-)	AMS, seizure	(-)	(-)	NA	NA	NA	1:16	1:512	2

Abbreviations: AMS, altered mental status; CRP, C-reactive protein; CT, computed tomography; HSM, hepatosplenomegaly; IgG, immunoglobulin G; IgM, immunoglobulin M; NA, not applicable as not obtained; LUQ, left upper quadrant; PCR, polymerase chain reaction; SI, sacroiliac.

^a The symbols "(+)" means present and "(-)" means absent.

^b Serum, biopsy, or aspirate *Bartonella henselae* PCR samples were positive for these patients.

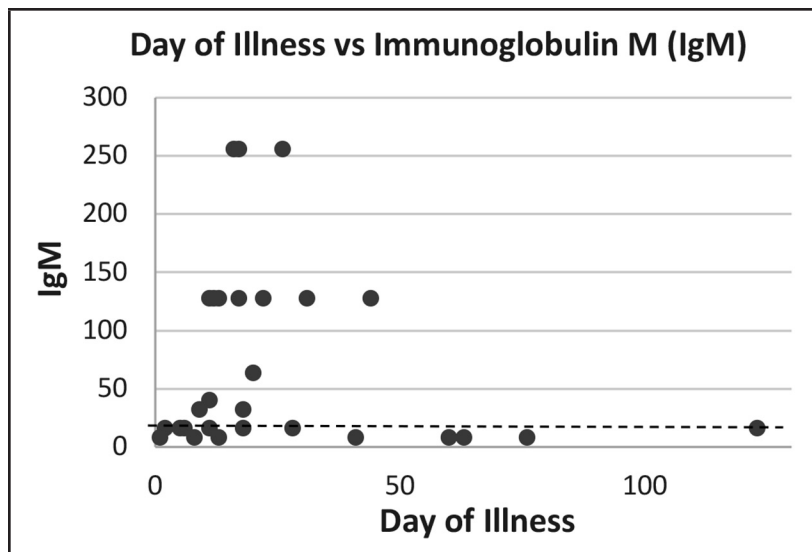


Figure 1. Positive Serological Diagnosis of *Bartonella Henselae* in Pediatric Disseminated Cat Scratch Disease Infections.

Bartonella henselae serological diagnosis measured by IgM versus day of illness. Data points at or above the dashed line (1:16 titers) are considered positive for recent or current infection. Day of illness was defined from onset of fever (or day of hospitalization if afebrile).

Patient	Disease category	Antibiotic therapy (inpatient/outpatient)	Total duration of treatment (d)	Time to fever resolution ^a (d)
1	liver/spleen abscesses	Az, Rif/Az, Rif	33	0
2	liver/spleen abscesses	NA/Az	5	NA
3a*	liver/spleen abscesses	Gent, TMP-SMX, Az/Gent, TMP-SMX	*	*
3b	liver/spleen abscesses	Gent, Rif, Dox/Rif, Dox	52	3
4	liver/spleen abscesses	Gent, Rif/Rif, TMP-SMX	48.5	3
5	liver/spleen abscesses	Az, Rif/Az, Rif	28	NA
6	liver/spleen abscesses	Az, Rif, Gent/Az, Rif	31	1
7	liver/spleen abscesses	Az, Rif, Gent/Az	37	7
8	liver/spleen abscesses	Az, Rif, Gent/Az, Rif	53.5	11
9	liver/spleen abscesses	Az, Rif, Gent, TMP-SMX/Az, Rif	39	11
10	liver/spleen abscesses	Az, Rif/Az, Rif	33	3
11	liver/spleen abscesses	Az, Rif/Az, Rif	42	2
12	Uveitis	NA/Az, Rif, Pred	58	NA
13	Osteomyelitis	Az, Rif/Az, Rif	21	1
14	Osteomyelitis	Az, Rif/Az, Rif	56	NA
15	Osteomyelitis	Az, Rif, Gent/Az, Rif, Gent	35	5
16	Osteomyelitis	Az, Rif/Az, Rif	35	3
17	Encephalitis	Az, Rif/Az, Rif	18	1
18	Encephalitis	Az/Az	14	2

Abbreviations: Az, azithromycin; d, days; Dox, doxycycline; Gent, gentamicin; NA, not applicable (patient was not hospitalized or did not have a fever); Pred, prednisolone; Rif, rifampin; TMP-SMX, trimethoprim-sulfamethoxazole.

^a Time to fever resolution is from time of admission.

* Patient 3 was readmitted due to persistent fever, which resolved 3 days into the second hospital stay.

Discussion

According to Bergmans, et al, a diagnosis of CSD usually requires 3 of the following 4 criteria: (1) a history of contact with a cat and the presence of a scratch or primary lesion of the skin, eye, or mucous membrane; (2) a positive cat scratch skin test reaction; (3) negative laboratory testing for other causes of lymphadenopathy; and (4) characteristic histopathological findings in a lymph node biopsy specimen or at a site of systemic involvement.³ The CSD intradermal skin test is no longer available, culture of *B. henselae* from lymph nodes is difficult, and many patients often do not recall a history of cat injury at the time of admission. Therefore, serological and molecular diagnostic methods are now utilized to diagnose CSD.

Based on the study results, Hawai'i has approximately 3.5 times the incidence of disseminated CSD compared to mainland United States. Over the decade, from 2009–2018, there were 18 cases of disseminated CSD documented at KMCWC. This likely represents most, if not all, diagnosed pediatric cases in the state of Hawai'i, as KMCWC is the only non-military pediatric hospital. National census data show there were 303 568 children living in Hawai'i in 2016; this results in an incidence of 0.593 per 100 000 children, which is much higher than the Centers for Disease Control and Prevention study estimating the inpatient incidence of CSD is 0.19 per 100 000 children.^{4,5} Jackson and colleagues found the incidence of CSD cases annually in the United States to be 22 000 cases.⁵ Most of the cases presented in February, July, September, and October, which varied from the mainland where most cases occurred in January, with another spike during August through November for inpatient admissions as reported by Nelson and colleagues.²

The overall incidence of CSD is likely grossly underestimated because it often self-resolves or its nonspecific symptoms can lead to misdiagnosis. While known to have a tropical climate, it is unclear why Hawai'i would have so many more cases than other humid parts of the United States. One hypothesis is this state has a higher incidence of fleas, wild or stray cats, or a higher bacterial load in the cats with mild weather allowing year-round outdoor exploration and exposure. Recent Hawai'i state congressional resolutions about feral cats suggest that they have grown in their numbers and are an increasing problem in the state.⁶ The Western Governors' Association, which includes Hawai'i, identified feral cats as 1 of the top 50 invasive species.⁷

Mainly categorized as an indolent and benign process, CSD can be disseminated, and thus, should be considered early in patients with prolonged fever without a source, even prior to reaching the 14 days of "fever of unknown origin" criteria. It should remain on the differential for patients even in the absence of fever or classic lymphadenopathy. The disseminated cases often occur in patients who are otherwise healthy, and though most have a full recovery, it can result in varying degrees of morbidity, and in rare cases, mortality. Many of these patients, including

the ones seen in the current review, present with prolonged fevers and undergo hospitalization with extensive laboratory testing and diagnostic imaging to make the diagnosis. Despite the growing body of literature surrounding disseminated CSD, there remains no formal recommendations regarding diagnostic workup and treatment with great variation in antibiotic choice and duration.⁸

Detection of antibodies against *B. henselae* by immunofluorescence assays or enzyme immune-assay has high sensitivity (88%) and specificity (97%).⁹ The diagnostic tool with the highest sensitivity remains *Bartonella* PCR performed on lymph node biopsy or abscess aspirate. CSD has a characteristic pleomorphic rod-shaped bacilli seen with the Warthin-Starry silver stain but bacterial culture has fallen out of favor given the bacterium's slow growth (1-4 weeks) and difficult primary isolation.¹

A retrospective study by Margileth, et al, revealed shorter mean duration of illness (2.8 versus 14.5 weeks) for those treated with rifampin, ciprofloxacin, gentamicin or trimethoprim-sulfamethoxazole (TMP-SMX) compared to other antibiotics as reviewed by Rolain, et al.^{8,10} Though no official treatment is deemed necessary for mild to moderate cases of CSD, a study by Bass, et al, demonstrated faster decrease in lymph node size in uncomplicated CSD cases treated with oral azithromycin for 5 days. The study demonstrated that 8 of 14 patients taking azithromycin had more than 80% improvement at 30 days versus 1 of 15 in the control group; however, both groups had similar resolution beyond the 30-day mark.¹¹ It has been proposed that the enlarged lymph nodes are an immunologic response and there are no viable bacilli by the time invasive interventions are performed, possibly an explanation for negative cultures but positive PCRs.⁸ Arisoy, et al, reported improvement in prolonged fever in patients with hepatosplenic CSD with combination therapy of TMP-SMX when rifampin was added to regimen, commonly for duration of 14 days.¹² Treatment approaches for reported complicated diseases have included azithromycin, rifampin, ciprofloxacin, trimethoprim/sulfamethoxazole, or gentamicin as monotherapy or in combination; however, there remains no formal guidelines regarding treatment of disseminated pediatric cases with hepatosplenic lesions or osteomyelitis.⁸

Study findings are in alignment with the proposition that titers and direct *Bartonella* PCR of tissue or aspirate remain the best diagnostic tools, though repeat titers later in the illness course may be needed if the patient has not yet seroconverted.⁹ If there is a high clinical suspicion for CSD in patients with prolonged fever without a source, testing should be sent while initiating empiric treatment, as laboratory test results may not return for several days. Ridder-Schroter and colleagues stated serum PCR is most useful in the first 6 weeks of infection, however, in all of our cases, even when obtained early in the disease course, the serum PCRs were negative.¹³ Serum PCR may be of limited utility later in the illness course when the patient is no longer bacteremic and the organism has seeded or is sequestered in

other areas of the body. While positive IgM titers represent active or recent *Bartonella* infection, it should be noted that there is risk of false positives given the prevalence of positive serology in 4-6% of the general population as demonstrated by Puri, et al.¹⁴ Prior studies suggest there is no association between titers and type of clinical presentation, and this study found similar results. There is previous documentation that IgM seropositivity can last up to 3 months but most of the IgM titers were negative by 40 days of illness.¹³

Combination antimicrobial therapy was used in all but one patient with resolution of fever and disseminated disease. Azithromycin with rifampin was part of the treatment regimen in over three quarters of disseminated cases and remains a common first choice. The treatment duration varied widely with no clear correlation with subtype of disseminated disease. The sites of osteomyelitis in these 4 cases were consistent with literature noting *B. henselae* axial predisposition (vertebrae then pelvic girdle, chest wall and skull). Hipp, et al, documented osteomyelitis cases treated with just 3 weeks of azithromycin without follow-up imaging.¹⁵ In Hajjaji's review, mean duration of osteomyelitis treatment was 32 days; however, nearly half of patients received short course antibiotic therapy (less than 6 weeks) and often with monotherapy, yet the prognosis remained good for all.⁹ Dornbos and colleagues switched to intravenous doxycycline and rifampin when azithromycin failed and treated until inflammatory markers normalized, stopping despite continued imaging findings.¹⁶ The combination of doxycycline and rifampin has been suggested for central nervous system disease in a study by Rolain, et al, which contrasts the 2 cases presented in this study treated with rifampin and azithromycin antibiotics.⁸ Rifampin and gentamicin have been suggested to be bactericidal based on in vitro studies, however, Rolain and colleagues work suggests this is only against bacterium outside erythrocytes. Moreover, minimum inhibitory and bactericidal concentrations often poorly correlate with the in vivo efficacies of antibiotics in patients.⁸

In this case series there was variable duration of therapy based on a combination of resolution of fever, normalization of inflammatory markers, and improvement on imaging studies. The authors propose a standardized first-line treatment regimen of azithromycin and rifampin for all patients with a variation of therapy duration based on organ involvement and clinical response. The authors suggest that CSD osteomyelitis be treated with a similar duration as other causes of osteomyelitis with 21 days of therapy or normalization of C-reactive protein and ESR, whichever is longer. For those with central nervous system involvement, 14 to 21 days of therapy based on clinical response would be appropriate. For patients with hepatosplenic disease, appropriate treatment duration would likely be 21 to 28 days. If clinical response is not sufficient, consideration should be made for adding gentamicin to the treatment regimen. It remains unclear if repeat imaging is necessary in these cases. While normalization of inflammatory markers is frequently utilized to assess disease resolution in other diseases, most CSD patients

do not have markedly elevated inflammatory markers, making these unreliable surrogates. In these cases, repeat imaging may assist in determination of successful treatment.

Limitations

Given this is a case series, causality or efficacy cannot be established. Additionally, this study has numerous limitations. Nelson and colleagues' epidemiological study utilized a private insurance base while most of this study's patients have government insurance, which may account for the discrepancy in inpatient incidence.² In this study, there were no positive blood cultures among patients but the majority of specimens were not held for the extended 21 days as recommended by the Centers for Disease Control and Prevention. Due to the nature of this retrospective study, some patient follow-up was not accessible or they were lost to follow-up. Finally, coding errors may have led to an incomplete data extraction.

Future Directions

While reviewing the data for this case series, there was a patient admitted with fever of unknown origin. The patient had been evaluated initially as an outpatient but was eventually admitted for inpatient care. The family had been asked about cat exposure and had repeatedly denied it. Multiple serologic studies were sent. A CT scan of the abdomen and pelvis was done to evaluate for an occult abscess, which proved negative. Subsequently, an abdominal ultrasound was done and microabscesses were noted in both the liver and the spleen. The family was then asked again about cat exposure and recalled that the patient's grandmother has kittens. At this time, *Bartonella* serological studies were negative, as could be expected from the results found in this study as the patient was about 30 days into the illness when the labs were drawn. The patient was empirically put on azithromycin and rifampin. Novel testing utilizing cell-free plasma next-generation sequencing test for pathogen detection returned positive for *B. henselae*. This case illustrated how the suspicion for CSD must remain high despite lack of cat exposure in the history, the diminishing utility of *Bartonella* titers later in the course (beyond 40 days), the greater sensitivity of ultrasound finding liver and spleen microabscesses, and the promise of new technology in finding this fastidious organism.

Further studies are needed regarding type and length of treatment, including when to reimaging or repeat laboratory testing and if and how this should guide total duration of therapy. Prospective studies would provide the most evidence regarding medication efficacy, complications, and long-term follow-up. Future efforts may also look into defining admission criteria. Collaborating with other facilities with additional CSD cases may allow stronger recommendations regarding noted trends in chart review. One goal of this study is to contribute to existing literature about disseminated CSD and foster awareness and disease understanding, thus facilitating prompt diagnosis, early treatment, and avoidance of unnecessary workup cost.

Conflict of Interest

None of the authors identify any conflict of interest.

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Youth Voice in Suicide Prevention in Hawai'i

Tran Trinh BS and Deborah Goebert DrPH

Abstract

Increasing evidence indicates that youth leadership programs that hold youth as key stakeholders are successful for suicide prevention. This project served to evaluate a train-the-trainer program for youth and their supportive adults. Hawaii's Caring Communities Initiative for Youth Suicide Prevention developed and practiced a youth leadership model to promote individual and community well-being and to decrease suicide risks. In collaboration with multiple community partners and the Hawai'i State Department of Health, Hawaii's Caring Communities Initiative brought together 57 youth and 17 supportive adults from around the state for the 2019 Prevent Suicide Hawai'i Conference: Hope, Help, and Healing, a 2-day, train-the-trainer workshop, consisting of games and activities centered towards education of suicide prevention methods, in early April 2019. Of the participants attending the workshop, 44 youth and 12 supportive adults completed surveys measuring knowledge about suicide prevention and local resources, and comfort level in delivering the programs. Open-ended questions were also used to assess whether key messages were conveyed. Quantitative analyses indicated the lessons helped the participants retain the information better and increased their comfort with the material. The power of youth voice was a common theme in the qualitative data, exemplified by the statement: "We can actually make a difference in our school and community." Findings suggest that youth engagement is an important factor in preventing suicide. Interventions centered on strength-based models of youth leadership may promote healing and enhance prevention strategies to address persistent suicide disparities in minority communities by promoting their voices in the community.

Keywords

Civil engagement, Hawai'i, suicide prevention, youth leadership programs, youth voice

Introduction

Over the last few decades, suicide death rates in Hawai'i and the United States have significantly increased, with dramatic increases among youth.¹ Youth Risk Behavior Survey findings over the last 20 years showed adolescents in Hawai'i self-reported among the highest rates of suicide-related behaviors, including depression, suicide ideation, planning, attempts, and attempts requiring medical attention.^{2,3} According to the most recent survey, 1 out of 6 high school students and 1 out of 8 middle school students in Hawai'i seriously considered suicide.⁴ For the last 5 years, suicide prevention was a leading concern at a statewide youth summit.

Studies indicated that programs that promote youth voice were successful in suicide prevention.^{5,6} Suicide prevention within the state and among youth provided the opportunity to spread education and awareness about suicide, and its impact on communities especially through the youth communities. The years between childhood and adulthood can be difficult in ways that

can lead an individual to suicidal thoughts and attempts. Despite how common such thoughts and attempts are among youth, educating and training the youth to become more aware and capable of tackling such disparities allowed more opportunities for those at risk to receive help. Ultimately, the youth relied on one another because they can relate more to each other and by raising awareness towards the youth communities, the youth suicide matter can benefit. Hawaii's youth suicide prevention programs were adapted to meet community and cultural needs, which emphasized the importance of honoring community knowledge and prioritizing relationships.^{7,8}

This project utilized approaches that support youth as the agents of change in their communities. Further, it served to evaluate the effectiveness of interactive activities on knowledge, recognition, comfort, and behaviors in suicide prevention through a train-the-trainer program, an accumulation of 2 evidence-based suicide prevention programs, Connect Suicide Prevention and Introduction to Sources of Strength, which was held as the 2019 Prevent Suicide Hawai'i Conference: Hope, Help, and Healing. It was hypothesized that interactive activities will improve learning, increase youth involvement, and ultimately, decrease youth suicide.

Methods

Middle and high school-aged youth and their supportive adults across the state of Hawai'i were invited to participate in the 2019 Prevent Suicide Hawai'i Conference: Hope, Help, and Healing. Notification about the workshop and conference for youth track were sent to supportive adult leaders of the Hawai'i Youth Leadership Council for Suicide Prevention as well as each of the County Prevent Suicide Task Forces to share with youth groups that had participated in previous suicide prevention events. As a result, the majority of participants were recruited from rural and primarily Native Hawaiian communities. The University of Hawai'i Institutional Review Board acknowledged the project as quality improvement with anonymous data; therefore, no formal approval was necessary. The principles outlined in the Declaration of Helsinki and the Belmont Report were followed. A draft permission form was shared with organizations for the conference describing the workshop and conference activities, including a statement that a survey would be done to get feedback on the program. This information was retained by all organizations. Some required additional paperwork for excursions and field trips. The youth attended with the permission of their parents and guardians and the supportive adults came as their chaperone.

Fifty-seven youth and 17 supportive adults from the islands of O‘ahu, Maui, Moloka‘i, Lana‘i, and the island of Hawai‘i engaged in a 2-day train-the-trainer program offered during the Youth and Supportive Adult Track at the conference. The majority of participants knew someone who had considered suicide, some had seriously considered suicide themselves, and a few had made an attempt themselves. Supportive adults were aware of this status and protections were in place to monitor youth if there was a concern. Precautions included supportive adults serving as chaperones that were aware of their youth’s needs, trained suicide prevention specialists monitoring the group for signs, and respite rooms.

Participants took part in interactive skills building activities and were given resources. Participants were trained and certified in 2 evidence-based programs, adapted for Hawai‘i, Connect Suicide Prevention and Intro to Sources of Strength. Connect Suicide Prevention training is a comprehensive, community-based approach to train professionals and communities in suicide prevention and response.^{3,9-11} Trainings focused on raising awareness of risk and protective factors and warning signs for suicide, reducing stigma, and ensuring communication using safe messaging guidelines. Sources of Strength is a universal suicide prevention approach that builds on protective influences of peers in schools and community.^{6,12} Sources of Strength Training improved peer leaders’ adaptive norms regarding suicide, their connectedness to adults, and their school and community engagement, with the largest gains for those entering with the least adaptive norms.

The combined program used training, relationship-building, youth empowerment, and implementation of community awareness projects. Modules were broken into 15-20-minute blocks with a purposeful game, teaching and sharing component, and an interactive activity. Examples are provided in Table 1. In the morning of day 1, attendees took part in the Connect Suicide Prevention training. Prior to lunch, they were divided into 3 groups and each group was given sections to present. The groups included both youth and supportive adults. In the afternoon, the trainees were given the opportunity to rehearse and present 2 blocks to ensure fidelity and provide feedback. The trainers made comments, noting areas of strength and improvement. The same strategy was employed on day 2 for Sources of Strength. All participants successfully delivered the programs in teams. Individual skills varied. All youth were certified to present with a trained supportive adult. The program also provided opportunities to meet and connect with other youth.

The youth and supportive adults were asked to complete the evaluation and turn in at the registration desk, as were all participants in the conference. Workshop attendees had the right to decline participation or not answer any question that made them uncomfortable. The survey contained Likert scale statements and open-ended questions. Evaluation is standard practice for the suicide prevention conference. The statements were presented

with a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). The 5 open-ended questions that were asked in the survey included: “What is a key message(s) that you took away from the Connect Training,” “What is a key message(s) that you took away from the Sources of Strength training,” “What did you find most helpful?,” “What would you change about this training?,” and “What will you do differently as a result of this training?”

All participants in the workshop were encouraged to practice what they had learned. This was not a requirement for participation in the workshop. This information was shared in thank you notes to the organizers for the conference and not systematically collected. The vast majority of supportive adults shared the ways that their groups applied their training in May 2019.

Descriptive analyses (frequencies and cross-tabulations) and comparative (χ^2 and Fisher Exact Test) were conducted to measure knowledge about suicide prevention, and comfort level with delivering each program using SPSS version 25 (IBM Corp: Armonk, NY). Qualitative data were analyzed by hand. The qualitative themes reached saturation with youth and supportive adults providing consistent comments on messaging and value of the training.

Results

Surveys were received from 44 youth and 12 supportive adults, for an overall response rate of 80% and 71%, respectively. The sample description appears in Table 1. The majority of youth respondents (64%) were from O‘ahu, consistent with participation in the youth track. Three-quarters of youth respondents were members of a youth suicide prevention group and nearly all respondents (98% of youth and 100% of supportive adults) had tried to help a friend or someone else that they thought might hurt themselves. Most of youth respondents (70%) had previously attended a suicide prevention training.

Youth and supportive adults reported increasing their knowledge and competence to prevent suicide in their own communities through the survey questions and in their feedback that was given after the conference concluded. There were no statistical differences between youth and supportive adults on any of the questions so the data were combined. The vast majority of respondents correctly answered questions related to knowledge including recognizing anger and hostility as signs of depression (96%), youth frequently tell someone of their plan to attempt suicide in advance (92%), and that asking about suicide will not encourage someone to act (98%). As illustrated in Figure 1, 83% of combined youth and supportive adult respondents indicated that youth have a role in suicide prevention. More than 81% of respondents felt they could teach Connect Suicide Prevention and Sources of Strength programs.

Program	Purposeful Game to Introduce	Share	Activity
Connect	"PostsActivity": The purpose of this game was to recognize that risks, warning signs, and support are not always easy to identify. This activity was added to augment the slides.	Some were asked to share why they think their quotes or social media posts belonged to a certain group. Some had different interpretations of the same quotes and posts as others.	Everyone was given a quote or post they had to identify as a risk, a warning sign, or positive message.
Sources of Strength	"Strength Poster": The purpose of this activity was to show that people all share similar strengths and at the same time have different strengths.	The similarities in the strengths that everyone had, which included family and friends, were discussed. The differences in strengths that everyone had that some can relate to, which included, canoeing, music, and friends, were also discussed.	Everyone was divided into groups. Every member had to then draw or write what, where, or who they drew their strength from during hardship. Every group came up with a group name and a way to share their poster in a creative way.

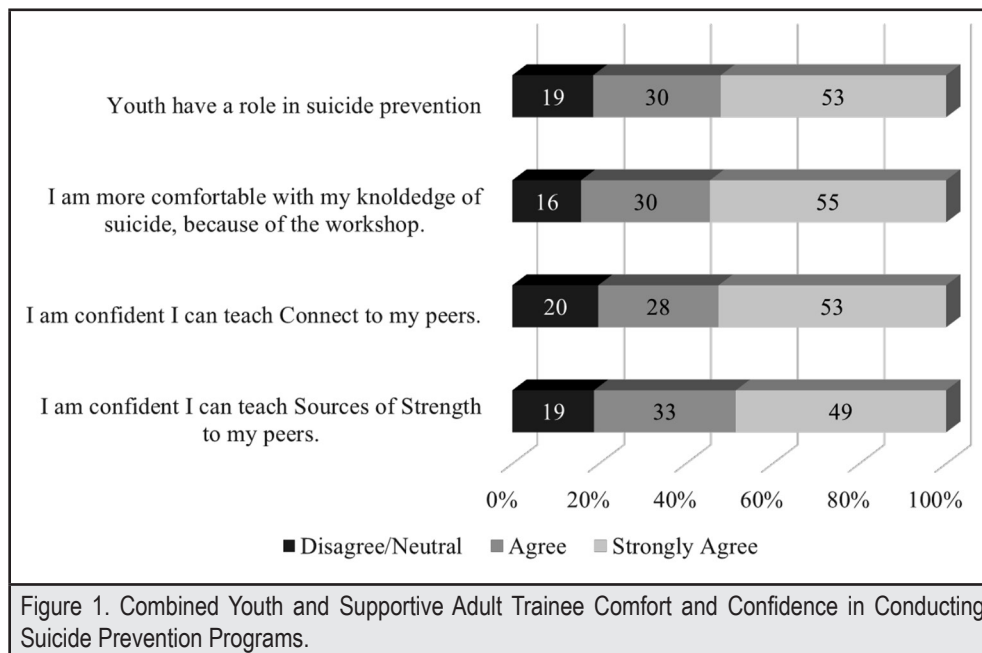


Figure 1. Combined Youth and Supportive Adult Trainee Comfort and Confidence in Conducting Suicide Prevention Programs.

Descriptors	Youth (N=44) n (%)	Supportive adult (N=12) n (%)	Statistics ^a
Gender			$\chi^2=1.84$, $df=2$, $P=.15$
Male	14 (32%)	2 (17%)	
Female	28 (64%)	10 (83%)	
Other ^b	2 (4%)	0	
Island			Fisher Exact Test $P=.15$
O'ahu	28 (64%)	5 (42%)	
Neighbor island ^c	16 (36%)	7 (58%)	
Helped a friend	43 (98%)	12 (100%)	Fisher Exact Test $P=.79$
Attended previous, suicide prevention training	30 (68%)	7 (58%)	Fisher Exact Test $P=.38$

^a χ^2 and the Fisher Exact Test were used to test relationships between participant type (youth, supportive adult) and categorical data. The Fisher Exact Test was used to when expected frequencies were fewer than five.

^b Participants who do not identify with their sex assigned at birth.

^c O'ahu is the most populated and hosted the conference in 2019. Neighbor islands refer to the less populated islands in the state of Hawai'i including Hawai'i Island, Lana'i, Maui, and Moloka'i. There were no participants from Kaua'i.

Key messaging for the suicide prevention programs were completely saturated. The key message of recognizing and connecting were indicated in all responses for the Connect Training program in some form. Some attendees highlighted recognizing signs, especially subtle changes, and others highlighted connecting to their friends or family members. The key message of strength was identified in all responses for the Sources of Strength program. Respondents either specified the wheel of strengths or described the need to identify their strengths, serving as a source for others, and looking to others to be a source of strength. Three themes emerged from the open-ended questions on value of the training (helpful, and do differently). The power of youth voice was the most common theme with 86% of youth and 100% of the supportive adults sharing that youth can lead and be empowered to prevent suicide in their communities. One youth wrote, *"We can actually make a difference in our school and community."* Another stated *"Suicide prevention is everyone's responsibility. I can be there for a person feeling like suicide."* Another youth stated, *"I know how to react better to certain situations, how to teach this info, and how to provide support."* This was reinforced by statements from supportive adults such as, *"Youth can do this. We need to allow them to lead."* and *"We need to make opportunities for youth to share this program on [my island]."* The second theme that emerged was the importance of focusing on strengths. This was repeated from the key messages on Sources of Strength with 68% of youth and 33% of supportive adults adding comments about focusing on strengths. One youth stated, *"There are strengths everywhere. Sharing about your sources of strength and support is important in a person's well-being."* A supportive adult commented, *"We need to spend more time focusing on strengths"* The final common theme was the role the activities played in training, indicated by 52% of youth and 42% of supportive adults. For example, one youth commented, *"I loved the games and activities. They made it easier for me to come out of my shell and step up to lead."* This was reinforced by the supportive adults as demonstrated by one of their comments, *"The game-share-activity style was so engaging, fun, and made for a quick impactful training."* Interesting, in the closing exercise for the training, nearly all participants specified the game activities or the opportunity to meet others as their favorite part of the conference.

Besides learning how to navigate others in suicide prevention, an additional hope of the conference was to have the trained youth and supportive adults teach and train others around them in the same way they were trained. In May 2019, youth from Moloka'i, Maui, and the Leeward Coast of O'ahu reportedly held sessions for their peers or teachers in suicide prevention. In less than 1 month, more than 150 additional youth and supportive adults have been trained by youth attending the youth track at the conference. Interventions centered on strength-based models of youth leadership may promote healing and enhance prevention strategies to address suicide by promoting their voices in the community.

Discussion

Youth suicide is an important and serious, yet preventable, community and societal issue. Interventions centered on strength-based models of youth leadership may promote healing and enhance prevention strategies to address persistent health disparities in minority communities by promoting their voices in the community. The power of youth voice was a common theme. The findings suggest that positive youth development is crucial in preventing suicide. Ongoing efforts to promote and sustain youth voice, youth training, and suicide prevention are needed. Overall, this study strengthens existing literature about the beneficial effects of programs grounded in positive youth development.¹³ Previous research shows that those who participated in youth development programs have refined their leadership and civic engagement skills, as well as their ability to make healthy decisions.¹⁴ Challenging youth to enhance their strengths require community investment. Youth want to be empowered to prevent suicide in their communities.

Given many participants were either involved in existing suicide prevention groups or were interested in creating such a group, they may not have been representative of the population of students in Hawai'i. Similar studies that include more communities are needed to determine if there are differences in program effectiveness. Student interest may have influenced the positive findings, including the high rates of knowledge, as well as their comfort and confidence with the material. Additionally, the majority of people who attended the conference agreed to evaluate the conference, though not every person turned in their survey. One community group was missing entirely, inadvertently misplacing their surveys. Therefore, this sample may not be representative of all conference attendees. Despite these limitations, this is the first time a peer train-the-trainer program of this magnitude relating to suicide prevention has been done in Hawai'i, and enthusiasm is being generated for future activities.

These results also have practical implications for youth suicide prevention programs on regional and national levels. Since suicide is a public health problem that is generally preventable, it is crucial to make evidence-based interventions available. The data from this study indicated that the use of interactive activities in these programs is one way to unite youth and adults who want to assist those considering suicide. In order for these programs and groups to continue, it is important to make training for supportive adults available and generate the necessary funding to sustain community work.

Conflict of Interest

The authors identify no conflict of interest.

Disclosure Statement

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The Hawai'i Child and Adolescent Psychiatry Resources for Primary Care: An Evidence-Informed Tool to Improve Quality of Care

Rachel Sy-Layug DO; Jillian Yoshimoto DO; Deborah Goebert DrPH; Anthony P.S. Guerrero MD; and Daniel Alicata MD

Abstract

Mental health continues to be a significant concern both globally and locally in Hawai'i, with nearly half of all mental illness beginning in childhood or adolescence. A shortage of mental health providers has led to less than a third of patients receiving appropriate and timely care. Primary care providers are often the first-line responders to untreated mental health conditions, but they are often underprepared to address these conditions. To help provide guidance to primary care providers and other first-line responders, a child and adolescent mental health resource manual was developed, that is tailored to Hawai'i. This manual was presented at several pediatric didactic sessions and general conferences to describe its evolution, utility, to elicit feedback, as well as for an initial distribution. While feedback was overall positive, future manual development and strategic updates will be made to insure its suitability and timeliness, while continuing circulation efforts to primary care providers will ultimately benefit a greater proportion of children in need.

Keywords

Adolescent, child, mental health, primary care

Abbreviations

JABSOM = John A. Burns School of Medicine
PCP = Primary care provider

Introduction

Pediatric Mental Illness and Access to Psychiatric Care

In the United States, mental health conditions, defined as conditions affecting mood, thoughts, and behavior, affect about 20% of youth with about half occurring in childhood (<12 years of age) and the other half with an onset during adolescence.¹ Less than one-third of those in need, receive appropriate and timely care, in large part due to the shortage of mental health providers.² Compounded by stigma, these conditions, left untreated, worsen with time and affect both mortality and disability among children and adolescents.³ Untreated and undertreated mental illness contributes to about one-third of excess cost and waste in our national health care system.⁴

In Hawai'i, the staggering shortage of mental health providers is further magnified by the dearth of psychiatrists on the neighbor islands.⁵ Although the prevalence of these conditions in Hawai'i is consistent with those across the country,⁶ ethnic and socioeconomic disparities unique to the islands further compound

this problem, as demonstrated by Andrade and colleagues.⁷ Common disorders in childhood include attention-deficit/hyperactivity disorder, anxiety, autism spectrum disorders, bipolar disorders, depression, eating disorders, disruptive behavior, and substance use disorders. Locally, Native Hawaiian youth had significantly higher rates of any psychiatric disorder (32.7%) when compared with non-Hawaiian youth (23.7%). This was due to significantly different anxiety disorder rates in Native Hawaiian.⁷ Furthermore, Youth Risk Behavior Survey studies from 1999–2009 show that Native Hawaiian and Pacific Islander youth self-reported the highest rates of suicide-related behaviors, including but not limited to depression, and suicide attempts.⁸ Native Hawaiians are more likely to live on the neighbor islands and rural parts of O'ahu, isolated from mental health resources. Proportionally, more youth from these rural communities present to emergency rooms for treatment of mood and anxiety disorders, with discharge to outpatient services or transferred to inpatient care than youth residing in urban and suburban areas.⁹

Role of Primary Care Providers

Primary care providers (PCPs) are critical to the care of youth with mental illness, particularly on the neighbor islands, as they are often the first-line responders to untreated mental health conditions. Only about 20% of medical centers in Hawai'i have access to onsite psychiatric consultation,¹⁰ so providing opportunities for education and training of mental health conditions is crucial to improving patient care in emergency settings.¹¹ However, PCPs can feel pressured or unprepared to address complex psychiatric conditions and in prescribing psychotropic treatments. Indeed, professional isolation is a constant challenge and stressor in rural settings when providing care for complex patients, which can lead to physician burnout.¹²

PCPs who feel competent in suicide prevention are more willing to assess and treat suicidal patients in health care and community settings.¹³⁻¹⁴ One goal of the National Strategy for Suicide Prevention is to increase the proportion of health care providers who receive training in the assessment and management of patients with risk of death by suicide. Indeed, this can be greatly reduced by 20%-70% via training of community-based mental health providers by recognizing and responding appropriately to suicidal individuals.¹⁵⁻¹⁶

The Department of Psychiatry within the University of Hawai‘i’s John A. Burns School of Medicine (JABSOM) has taken a leadership role in ensuring education and training needs are met in community and clinical settings with tangible benefits as physician education in suicide prevention has been shown to reduce suicide rates.^{9,17} The DOP has also been involved in pilot programs involving behavioral health care integration in rural primary care settings in Hawai‘i and elsewhere in the Pacific.^{12,18} However, even for these pilot programs, structured to enhance accessibility of psychiatric expertise in rural primary care settings and provide real-time psychiatric consultation and supervision/training for PCPs, a need for accessible, relevant, up-to-date, and evidence-based resource manuals remains.

Methods

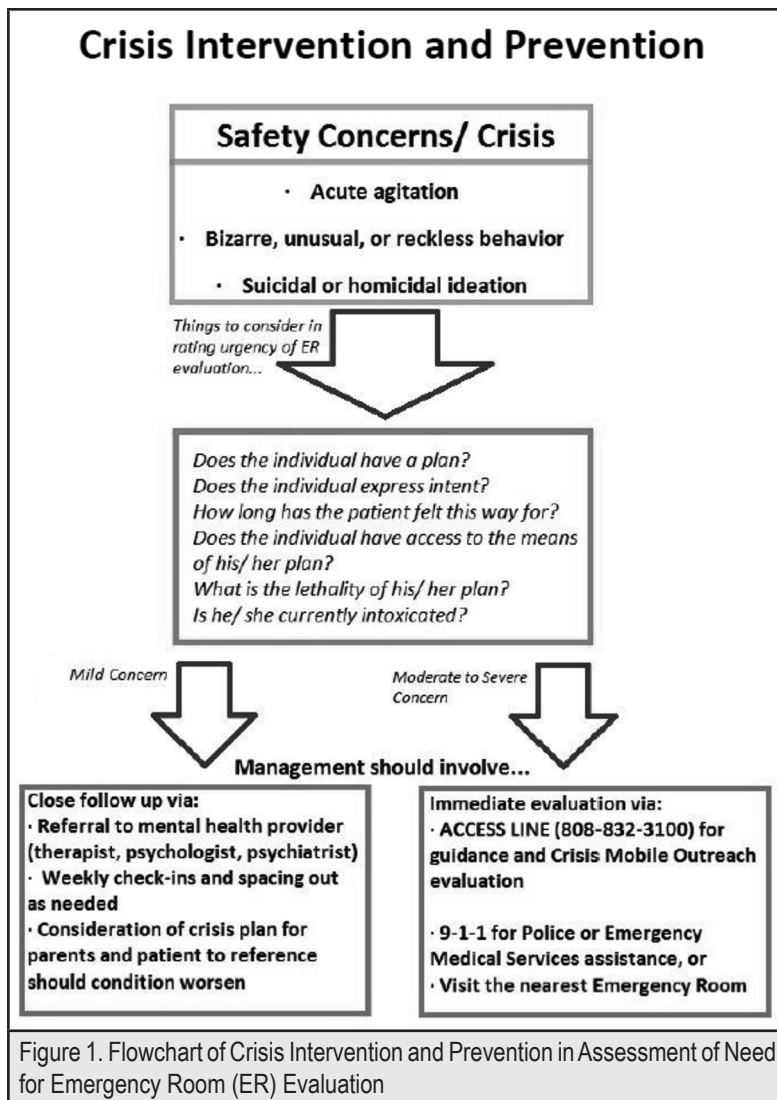
This quality improvement project was conducted by the Chief Fellows in child and adolescent psychiatry. The project goal was to develop and disseminate a handbook for PCPs to guide triage and psychiatric safety issues, manage basic psychiatric conditions, and recognize when to obtain specialized guidance for more complex psychiatric conditions. The goal was to mitigate some of the professional isolation experienced by PCPs in order to embolden them to approach mental health conditions with more confidence, as well as to offer their patients recommendations for additional community resources.

The manual was based on a similar publication from Seattle Children’s Hospital, which focused on conditions that their primary care colleagues often sought guidance with.¹⁹ The resources were tailored to those conditions considered relevant, as well as the appropriate resources available in the state and in the nation. Although the Chief Fellows did not engage the PCPs in the creation of this manual, the experience working with PCPs over time, especially those unfamiliar with managing basic psychiatric conditions and subsequently seeking appropriate resources, informed the writing group with the content and overall dimension of the manual. In order to compile a manual of resources, the authors looked to our training program for expertise as the training program included various sites that worked specifically with child populations, and the treatment teams consisted of members from various disciplines. The treatment teams included health care professionals in the community, such as social workers, researchers, and child and adolescent psychiatrists (both in practice and in training). Several questions were informally asked of them regarding the resource information they thought would be helpful to a PCP looking for guidance in managing mental health care needs. After integrating the catalogued resource information with the treatment guidelines, the Hawai‘i Child and Adolescent Psychiatric Resources for Primary Care Manual was completed. The University of Hawai‘i’s Institutional Review Board acknowledged the project as quality improvement rather than research. Therefore, no formal review approval was necessary. The principles outlined in the Declaration of Helsinki and the Belmont Report were followed.

Results

The Hawai‘i Child and Adolescent Psychiatry Resources for Primary Care Manual includes sections on how to access a provider, how to access community resources (eg, Hawai‘i State Department of Health Child and Adolescent Mental Health Division and affiliated Family Guidance Centers), and a basic safety assessment tool called the “Crisis Intervention and Prevention” flowchart (Figure 1). For the most common pediatric mental health complaints presenting to the PCP, diagnosis and treatment flow charts as well as affiliated local and national resources are included. This is in alignment with the flow charts of the Seattle Children’s Partnership Access Line, which created a similar guide specific for the Washington State area.¹⁹ The manual included multiple mental health disorders: attention-deficit/hyperactivity disorder, anxiety, anxiety spectrum disorders, bipolar disorder, depression, disruptive behavior, and substance use disorder. The manual is available on the DOP JABSOM website under the resources tab. The manual also includes case presentations to inform the PCP. An example case involves a PCP with a 14-year-old patient seen in the office with suicidal ideation in the context of depression. The PCP, using the crisis flowsheet shown in Figure 1, and other resources included in the manual, determines the necessity for emergency intervention based on the presenting risk factors. If the risk is low, the PCP is guided with an additional flowsheet detailing medication treatment options, scales for further assessments, as well as community resources appropriate for individuals with depression. Conversely, if initial primary care driven interventions are insufficient, PCPs are also provided with information regarding how to refer a patient for more specialized psychiatric care services.

This manual was first presented at the annual Hawai‘i Association of Osteopathic Physicians and Surgeons Conference in March 2017, and subsequently as an in-service at JABSOM, a Department of Pediatrics presentation lecture, and a Continuing Medical Education luncheon at the Queen’s Medical Center. In addition to providing an overview of the manual, these presentations were held, in part, to elicit feedback for improvement. The audiences were chosen based on the desire to address a wide spectrum of PCPs, including general pediatricians affiliated with the 2 major community hospitals in Honolulu. To be sure, these providers are often first-line physicians involved in managing mental health conditions, who are also tasked with determining whether additional referrals to specific mental health providers are needed. After presenting the overview of the content and instruction on the use of the manual followed by a question and answer period, the manual was available for immediate distribution. The writing team did not systematically catalogue any formal feedback, nor did they seek or receive critiques of the manual after the distribution. Nevertheless, the response from PCPs in the community was perceived as very positive, and the authors will formally solicit feedback in the future to inform future editions. This manual has also been used as a resource for medical students’ psychiatry clerkship, general



psychiatry residents, and child and adolescent psychiatry fellows while rotating through the inpatient child and adolescent psychiatry unit. The document is will be updated annually or as best practices evolve. The process will be managed by the original author who is a practicing psychiatrist (RSL) engaged in both inpatient and outpatient psychiatric care.

Discussion

Feedback from the local practitioners was positive over the utility of the manual, while acknowledging its primary focus on Hawai‘i. Indeed, the intended use in our local community guided the selection of content, tailored to medical practitioners in the state of Hawai‘i as well as concentrating on identifying appropriate health care resources. A manual applicable to a nationwide audience would also be of value. To be sure, the

broader distribution would result in assisting PCPs globally in providing greater access to those seeking mental health services. Finally, the utility of formal user feedback may be exploited to inform future updates in an ongoing adaptation of the handbook’s content, as well as an assessment tool of its usefulness. In this context, the utility of the manual may also be linked to numerous longitudinal assessment measures, including increased health care quality, increased accessibility, improved timeliness of diagnosis and treatment, established cost effectiveness (as assessed through rates of psychiatric hospitalizations and emergency visits), and decreased suicide and violence rates in the community.

Conflict of Interest

None of the authors identify any conflict of interest.

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Protecting Youth in the Mental Health Service Settings

George K. Makini, Jr. MD; Earl S. Hishinuma PhD; Anthony P.S. Guerrero MD; and Deborah A. Goebert DrPH

Abstract

The authors present the development of the field of psychiatry with the evolution of patient safeguards. They address the recent publicized events involving sexual harassment and abuse perpetrated by mental health service providers who have harmed youth who were under their direct psychiatric care. Recommendations are provided for primary care physicians and parents and legal guardians to further ensure patient safety.

Keywords

Adolescents, boundaries, children, mental health, patient safety, professional standards, resources

Abbreviations

APA = American Psychiatric Association
CWS = Child Welfare Services
PCP = primary care physician
RICO = Regulated Industries Complaints Office
YRBS = Youth Risk Behavior Survey

Introduction

The issues of sexual harassment and sexual abuse have become very prominent in social media and the popular press. Professions and institutions that were trusted and revered in the past have been shown to be complicit to varying degrees. Practitioners working with children and adolescents have not been immune, including those working in the fields of education and mental health. For example, school officials, teachers, and mental health practitioners have crossed ethical, professional, and legal boundaries. In the case of physicians, they take the Hippocratic Oath, which explicitly prohibits such conduct: “In every house where I come I will enter only for the good of my patients, keeping myself far from all intentional ill-doing and all seduction, and especially from the pleasures of love with women or with men ...”¹

When instances of sexual misconduct have occurred, children and youth have been significantly harmed, and people are then, rightfully, less likely to trust and seek out help from practitioners in these professions. Not seeking professional help for mental health services would be very unfortunate given the already underserved children and adolescents who have mental health needs, the proven effectiveness of evidence-based mental health interventions, and the current reasonable safeguards already in place and courses of action that can be taken.

Within this context, this article addresses the issue of mental health practitioners who work with children and adolescents, with particular focus on child and adolescent psychiatry. This study first delineates the progress of patient safety, particularly as this applies to the mental health field, summarizes current needs and concerns, and finally highlights future directions to safeguard patients.

Historical Perspective

To understand what current safeguards are present in child-adolescent psychiatry, one has to review the developmental stages of general and child-adolescent psychiatry. In 1946, The National Mental Health Act was passed, resulting in the establishment of the National Institute of Mental Health—a new federal agency to sponsor research and training in psychiatry to encourage the development of improved mental health care methods. This act made mental health care a federal priority. It was inspired by alarm at the poor mental health of some draftees and veterans and was demanded by veterans and their families. This amendment to the Public Health Service Act provided for research relating to psychiatric disorders and the development of more effective methods of prevention, diagnosis, and treatment of such disorders, and for other purposes.²

In 1955, the Joint Commission of Mental Illness and Health was created to seek ways to increase support of mental health services, training, and research; evaluate the role of hospitalization in patient treatment; and promote mental health.³ In 1961, this Joint Commission submitted a report, *Action for Mental Health*, advocating a shift of care away from the institutional, or “paternalistic” care model to a community-based mental healthcare model.⁴

Subsequently, legislation from the administration of President John F. Kennedy, the Community Mental Health Act, also known as the Mental Retardation and Community Mental Health Centers Construction Act of 1963, was passed by the United States (US) Congress. This act mandated the appointment of a commission to make recommendations for “combating mental illness in the United States.”⁵ A growing body of evidence at that time demonstrated that mental illnesses could be treated more effectively and in a more cost-effective manner in community settings than in traditional psychiatric hospitals. It was the beginning of the shift away from the “paternalistic” patient-physician relationship to a “patient-centered” relationship. The “paternalistic” relationship had the physician as sole decision-

maker for the patient's care with the belief that the physician was the only one who could make choices of interventions that best promoted the patient's health and well-being. The physician used his or her knowledge and skills to determine the patient's medical condition and stage of disease process and identified the medical tests and treatments most likely to restore the patient's health or relieve discomfort.⁶ In contrast, the "patient-centered" relationship provides care that is respectful of, and responsive to, individual patient preferences, needs, and values, and ensures that patient values guide all clinical decisions.⁷

The 1969 National Joint Commission on the Mental Health of Children found that millions of children and youth were not receiving needed mental health services.⁸ Many of the children who were served received inappropriate, unnecessarily restrictive care, often in state mental hospitals. Then, in 1978, under President Jimmy Carter, the President's Commission on Mental Health echoed the Joint Commission's conclusions, finding that few communities provided the volume or continuum of programs necessary to meet children's mental health needs.⁹ Both Commissions recommended that an integrated network of services be developed in communities to meet the needs of severely emotionally disturbed children and youth.

Progress

The US Congress appropriated funds in 1984 for the Child and Adolescent Service System Program. This endeavor envisioned a comprehensive mental health system of care for children, adolescents, and their families. Since 1985, the mental health field has shifted from viewing parents as the cause of their child's issues to active participants in treatment, policy development, and system-reform efforts. Overall, research demonstrated that better outcomes are achieved when family members and youth have meaningful roles in their treatment.¹⁰

In 1991, Trupin, et al, found that children with behavioral health conditions were in need of a variety of mental health services.¹¹ Significant differences in the needs of boys versus girls, and of different-aged children, were present and had serious implications for service system development. Thus, families and surrogate families of children with behavioral health conditions should be full participants in all aspects of the planning and delivery of services.¹² The system-of-care concept was the foundation of the Federal Comprehensive Community Mental Health Services for Children and Their Families Program, also referred to as "the Federal children's mental health initiative." Since 1992, this program provided more than \$1 billion in resources to build systems of care nationwide under the auspices of the Substance Abuse and Mental Health Services Administration within the Center for Mental Health Services.¹³ One expectation from the establishment of this program was heightened awareness of the concepts of boundaries, boundary crossings, and boundary violations would improve patient care and contribute to effective risk management.¹⁴ Since the early

1990s, this change in approach to pediatric mental health care, has demonstrated significant benefits as evidenced by improvements in systems and in the social and emotional functioning of children, youth, and families. The updated concept and philosophy were intended to assist the field to continue this progress to improve the lives of children and families.¹⁵

In 2001, with awareness of the high mortality rates (eg, up to 98 000 deaths per year among US hospitalizations) associated with preventable medical errors, the Institute of Medicine recommended 6 aims to improve the quality of a health care system, namely making it safe, timely, effective, efficient, equitable, and patient-centered.¹⁶ This report was initiated in the same year that the American Psychiatric Association (APA) appointed a group of prominent members to create the APA Task Force on Patient Safety. This task force developed recommendations for psychiatric residency programs to include patient safety in the curriculum. These recommendations were in response to issues at the time in which graduates of these programs gained extensive experience in various psychiatry subspecialties but were often naïve to patient safety and the quality of care rendered through improved systems of care.¹⁷

Contemporary Child-Adolescent Psychiatry

Current Mechanisms to Reduce Patient Harm and Optimize Safety in Psychiatry

The mere fact that patients have been harmed by boundary transgressions indicates that, like all other medical specialties, psychiatry must optimize its processes to ensure patient safety, quality of care, and public accountability. Certain specialties have been leaders in this regard and may serve as role models. Anesthesiology was the first medical discipline to advance internal safety standards. At the turn of the 20th century, there was an international controversy over the precise dosing and delivery of chloroform. For the next 50 years, anesthesiologists witnessed a disproportionate number of patient deaths despite a growing body of knowledge in the field. As international research began to accrue in the area, it became evident that inconsistent and poor data were inadequate to explain widely divergent mortality rates.¹⁸ In 1985, the Anesthesia Patient Safety Foundation was launched. With its momentum and influence, it served as a model for cutting-edge, cost-effective patient safety and clinical-culture research, design, and simulation. Anesthesiology adopted safeguards that involved national standards, monitoring, transparency, patient-centered focus, interdisciplinary teamwork, and inter-team member accountability.¹⁹

While psychiatry is different in many respects from anesthesiology, the latter being a more procedurally oriented specialty, the 2 specialties are similar in that they both take care of potentially vulnerable patients; that is, patients whose judgment may be affected by distress or other cognitive or developmental conditions, or patients who are not fully awake and who are

dependent on others for life-sustaining functions. It is hypothesized that, in contemporary practice, there are safeguards that contemporary psychiatric practices have already adopted or are working to adopt that reduce the risk of patient harm. Some of these safeguards are fundamental, similar to the way that certain safeguards in anesthesiology (eg, routine monitoring of oxygen saturation and end-tidal carbon dioxide, engineering of gas delivery equipment to prevent the patient from receiving any oxygen concentrations lower than ambient air, etc) are fundamental to significantly decrease the likelihood of patient harm. Several of these safeguards are also imperative in administrative processes. Most importantly, all patients or their guardians must provide formalized consent to evaluation and treatment, both in the initial assessment and whenever there is a meaningful change in treatment plan. It should be noted that psychotherapy, like medications or any other medical procedure, also needs to be carefully defined in terms of what it entails and its risks and benefits to patients and families.

Patient safety is also improved with greater involvement of the family. With an increasingly robust evidence base for the effectiveness of family- and systems-based treatments, it is no longer acceptable to conduct private individual sessions where none of the patient's family is in the room or otherwise readily available. Federal and state laws have more explicitly defined and improved our understanding of privacy, such that there is clearer permission for communication with guardians of minors, "circle-of-care" providers, and others directly involved in patient care. Further, psychiatry has evolved to embrace a more team-based approach. With collaborative care, there are checks and balances among the different specialties who communicate with one another, and opportunities for patients to speak with more than 1 person should there be concern about their current health care provider. The APA and the American Academy for Child and Adolescent Psychiatry have each published codes of ethics that are required readings during training and that help to more clearly define acceptable and unacceptable clinical practices for all providers.

As psychiatry becomes more integrated within large health care organizations, which in turn, are accountable to health care consumers and other stakeholders, there is higher value placed on patient-family feedback and satisfaction. Clinical processes have, therefore, evolved to include regular opportunities, often during a portion of the session, to receive feedback from patients and guardians.

Current Mental Health Needs

The current mental health needs of children and adolescents are substantial. Obtaining mental health care for children worsened in 2004 when the US Food and Drug Administration issued a warning on antidepressants, indicating they were associated with an increased risk of suicidal thinking, feeling, and behavior in young people. This warning negatively affected pediatric patients diagnosed with depression because it discouraged parents from

seeking mental health care for their children and discouraged physicians who were not psychiatrists from prescribing antidepressants when these medications were clinically indicated.^{20,21}

By 2005, a comprehensive, simultaneous, and integrated approach was needed to achieve real progress in children's mental health.²² Data collected from the Youth Risk Behavior Survey (YRBS) helped defined the mental health needs of children and adolescents. The YRBS was created in the early 1990s to monitor the leading causes of death among youth and premature death in adults and progress towards protecting youth from human immunodeficiency virus (HIV) infection. Currently, the YRBS is a biennial survey of US adolescents that measures the prevalence of multiple health risk and health protective behaviors, such as smoking, drinking, drug use, diet, and physical activity. One measure of depressive symptoms from the YRBS assesses feeling of sadness and hopelessness in the question, "[Have you] felt sad or hopeless almost every day for 2 or more weeks in a row so that they stopped doing some usual activities during the 12 months before the survey." Thirty percent of our local and national youth endorsed serious depressive symptoms.²³ Additionally, YRBS data showed that 16% seriously considered attempting suicide during the past 12 months.²³ Another study, the National Survey on Drug Use and Health (2013-2014), found 9% of youth reported at least 1 episode of major depression.²⁴ These findings help established a baseline for the pervasive mental health needs of youth.

Current Concerns and Remedies Regarding Boundary Issues

All physicians should practice in accordance with the medical code of ethics set forth in the Principles of Medical Ethics of the American Medical Association. In brief, it states, "A physician shall... report physicians deficient in character or competence, or engaging in fraud or deception, to appropriate entities."²⁵ The APA incorporated many of the AMA's principles. It states, "When a person with personal knowledge believes an APA member may have violated these ethical principles, they may file a complaint with the APA District Branch to which the member belongs. Complaints are handled in accordance with APA's procedural code by the District Branch's ethics committee. Appeals from District Branch decisions are made to the APA Ethics Committee." In Hawai'i, the APA District Branch is located as part of Hawai'i Psychiatric Medical Association. In the same office is the Hawai'i Medical Association District Branch, which also receives reports of concerns or complaints. Table 1 provides recommendations for primary care physicians and parents and guardians. Primary care physicians should encourage parents and guardians who fear that their child's safety has been or is endangered by a psychiatrist to call 911 and to contact the state's Regulated Industries Complaints Office (RICO). Most people are not aware of RICO's function to investigate and prosecute possible licensing law violations by Hawai'i licensees. RICO also works to protect consumers from unscrupulous and unqualified individuals by investigating and prosecuting unlicensed activity.

Table 1. Recommendations for the Primary Care Physician (PCP) and Parents and Guardians of Your Patients
For PCPs:
1. Solicit from your colleagues a list of tried and trusted therapists
2. Professionally get to know the psychotherapists to whom your patients are referred
3. Ask for feedback from your patients and parents/guardians about their experience with the therapist
4. Concerns or complaints of a psychiatrist: Hawai'i Psychiatric Medical Association, 1360 S. Beretania St., Suite 200, Honolulu, Hawai'i 96814; Phone: (808) 536-7705; Email: office@hawaiiipsychiatry.org Hawai'i Medical Association, 1360 S. Beretania St., Suite 200, Honolulu, Hawai'i 96814; Phone: (808) 536-7705; Email: office@hawaiimedicalassociation.org Regulated Industries Complaints Office (RICO) of the State of Hawai'i ; Phone: (808) 587-4272; Website: http://cca.hawaii.gov/rico/
For parents and guardians:
When faced with your child's need to be seen by a therapist, the following are recommendations to ensure your child's protection:
1. Ask for a referral from your child's PCP, if not already done
2. Use "When to Seek Help for Your Child" at "Facts-For-Families" by the American Academy of Child and Adolescent Psychiatry (www.aacap.org .)
3. Find references about the referred therapist from: <ul style="list-style-type: none"> • Hawai'i Psychiatric Medical Association's Psychiatrist Finder (www.hawaiiipsychiatry.org) • American Academy of Child and Adolescent Psychiatry's Child and Adolescent Psychiatrist Finder (www.aacap.org) • Hawai'i Psychological Association Find a Psychologist (www.hawaiipsychology.org) • Psychology Today Find a Therapist (www.psychologytoday.com) • Hawai'i's Therapy Directory (www.hawaiitherapist.com) • Parents/Guardians' Health Insurance Plans Websites
4. Once an appointment is set, expect and ensure the following: <ul style="list-style-type: none"> • At least 1 or more parent(s)/guardian(s) is/are involved with the initial evaluation and ongoing therapy. • Be involved at the beginning and end of every session to ensure communication of the proposed treatment plan, safeguard your child's protection and comfort, and monitor the progress of your child's condition with the therapist.
5. When parents and guardians have founded fears that their child's safety is endangered by a psychiatrist, support him or her with the following: <ul style="list-style-type: none"> • Call 911 • Call the child's PCP • Contact RICO Complaint History Search of the State of Hawai'i of the Department of Commerce and Consumer Affairs at (808) 587-4272 or www.cca.hawaii.gov/rico

For parents and guardians, when to seek help may be a difficult decision. However, they are usually the first to recognize that their child has a problem with emotions or behaviors (Table 2). The first step is to try to gently talk to the child. An honest and open talk about feelings can often help. They may choose to check with the child's physicians, teachers, members of the clergy, or other adults who know the child well. These steps may resolve the problems for the child and family. If the problems are not resolved, then there are sources available to find help (Table 3). If difficulty arises in finding a therapist, there are steps to work with the health insurer (Figure 1). For families that do not have health insurance, parents and guardians may contact their nearest Family Guidance Center, which is sponsored by the Child and Adolescent Mental Health Division of the Hawai'i State Department of Health. Table 3 provides a list of Family Guidance Centers by island and region.²⁶

Child Abuse or Neglect Reporting

Any mandated reporter who has reason to believe that child abuse or neglect will occur in the reasonably foreseeable future, must immediately report the matter to Child Welfare Services (CWS) or to their local police department.²⁷ CWS is a social service provided to children and their families when children are reported to have been harmed, or are at risk of being harmed. Child Protective Service is 1 of several child welfare programs

in the Social Services Division of the Hawai'i Department of Human Services. Local CWS offices created a guide for potential reporters that offers important information about key aspects of child abuse or neglect reporting, including what legally defines child abuse or neglect, who is mandated to report, when to report, how to report, and what pertinent information should be sent to the designated CWS office. It also encourages the potential reporter to discuss questionable cases to decide whether or not a case should be referred.²⁸ For example, reporters who suspect Munchausen syndrome by proxy,²⁹ a type of medical child abuse, should contact CWS for consultation.

Future Directions to Safeguard Patients

Along with psychiatry's adoption of processes to optimize safety, quality, and accountability, other efforts to improve public awareness of sexual boundary crossings and to improve the culture of children's safety must continue. It remains very important to educate all children, starting at an early age, about safe and unsafe touching, and the need to always tell parents and guardians, regardless of what they might be told to the contrary, should anyone be engaging in unsafe touching. This type of education should include role-play scenarios involving ostensibly benevolent people like physicians and counselors and should include a discussion on how to respond assertively to threats not to tell anyone. All professionals who work with

Table 2. Signs That a Child and Adolescent Psychiatric Evaluation Would Be Useful ^{a,b}
Preschool and Elementary School Children
• Marked fall in school performance
• Poor grades in school despite trying very hard
• Severe worry or anxiety, as shown by regular refusal to go to school, go to sleep or take part in activities that are normal for the child's age
• Frequent physical complaints
• Hyperactivity, fidgeting, constant movement beyond regular playing with or without difficulty paying attention
• Persistent nightmares
• Persistent disobedience or aggression (longer than 6 months) and provocative opposition to authority figures
• Frequent, unexplainable temper tantrums
• Threats to harm or kill oneself
Middle School and High School Children
• Marked decline in school performance
• Inability to cope with problems and daily activities
• Marked changes in sleeping and/or eating habits
• Extreme difficulties in concentrating that get in the way at school or at home
• Sexual acting out
• Depression shown by sustained, prolonged negative mood and attitude, often accompanied by poor appetite, difficulty sleeping or thoughts of death
• Severe mood swings
• Strong worries or anxieties that get in the way of daily life, such as at school or socializing
• Repeated use of alcohol and/or drugs
• Intense fear of becoming obese with no relationship to actual body weight, excessive dieting, throwing up or using laxatives to lose weight
• Persistent nightmares
• Threats of self-harm or harm to others
• Self-injury or self-destructive behavior
• Frequent outbursts of anger, aggression
• Repeated threats to run away
• Aggressive or non-aggressive consistent violation of rights of others; opposition to authority, truancy, thefts, or vandalism
• Strange thoughts, beliefs, feelings, or unusual behaviors

^a If problems persist over an extended period of time or if others involved in the child's life are concerned, consider speaking with or seeking a consultation with a child and adolescent psychiatrist or a trained mental health professional.

^b American Academy of Child and Adolescent Psychiatry, "When to Seek Help for Your Child" at "Facts-For-Families". https://www.aacap.org/AACAP/Families_and_Youth/Facts_for_Families/FFF-Guide/When-To-Seek-Help-For-Your-Child-024.aspx. Accessed December 14, 2019.

children should reinforce these messages. During physical examinations, they should remind children that no one should be touching their private parts, and that even the provider needs permission to touch them and should only do so with a parent or guardian present. Finally, for children receiving mental healthcare services, providers should help to debunk the myth that these services are shrouded in secrecy and obligatorily exclude parents and other concerned adults.

Child and adolescent psychiatrists hold sacred the trust of our patients, families, and communities. This trust extends to avoiding harm and making our services fully available, without stigma or barrier, for all those in need. All psychiatrists have sworn to an oath to uphold this sacred trust.

Conclusion

This review and guidance offer accurate information about important developments in psychiatric and other mental health care services for children and adolescents, including higher attention to safety, advancement of transparency with treatments, and a clearer understanding of the behavioral health status of our youth. It is hoped that, with this information, providers and other stakeholders will help patients and families to make informed choices about mental health care.

Conflict of Interest

None of the authors identify any conflict of interest.

Table 3. State of Hawai'i Family Guidance Centers Contact Information ^a		
Island	Region	Contact information
O'ahu	Honolulu	3627 Kīlauea Avenue, Room 401, Honolulu, Hawai'i 96816 Main Line: (808) 733-9393; Fax: (808) 733-9377
	Pearl City	860 Fourth Street, 2nd Floor, Pearl City, Hawai'i 96782 Main Line: (808) 453-5900; Fax: (808) 453-5940
	Leeward	601 Kamokila Boulevard, Suite 355, Kapolei, Hawai'i 96707 Main Line: (808) 692-7700; Fax: (808) 692-7712
	Kāne'ohe	45-691 Kea'ahala Road, Kāne'ohe, Hawai'i 96744 Main Line: (808) 233-3770 Fax: (808) 233-5659
Maui (County)	Wailuku	270 Waiehu Beach Road, Suite 213, Wailuku, Hawai'i 96793 Main Line: (808) 243-1252; Fax: (808) 243-1254
	Lāhainā	1830 Honoapi'ilani Highway, Lāhainā, Hawai'i 96761 Main Line: (808) 662-4045; Fax: (808) 661-5450
	Lāna'i	C/O Lāhainā Office, 1830 Honoapi'ilani Highway, Lāhainā, Hawai'i 96761 Main Line: (808) 662-4045; Fax: (808) 661-5450
	Lāna'i High and Elementary Schools	555 Fraser Avenue, Lāna'i City, Hawai'i 96763 Main Line: (808) 565-7900; Fax: (808) 565-7904
	Moloka'i	65 Makaena Place, Kaunakakai, Hawai'i 96748 Phone: (808) 553-7878; Fax: (808) 553-7874
Hawai'i	Kamuela	65-1230 Māmalahoa Highway, Suite A-1, Kamuela, Hawai'i 96743 Main Line: (808) 933-0610; Fax: (808) 933-0558
	Hilo	88 Kanoehua Avenue, Suite A-204, Hilo, Hawai'i 96720 Main Line: (808) 933-0610; Fax: (808) 933-0558
	Kona	81-980 Haleki'i Street, Room 101, Kealahou, Hawai'i 96750 Main Line: (808) 322-1534; Fax: (808) 322-1543
	Waimea	65-1230 Māmalahoa Highway, Suite A-1, Kamuela, Hawai'i 96743 Main Line: (808) 887-8100; Fax: (808) 887-8113
Kaua'i	Līhu'e	3059 'Umi Street, Room A014, Līhu'e, Hawai'i 96766 Main Line: (808) 274-3883; Fax: (808) 274-3889

^a Adapted from the State of Hawai'i, Department of Human Services, Child Welfare Services, "A Guide for Mandated Reporters" November, 2007.

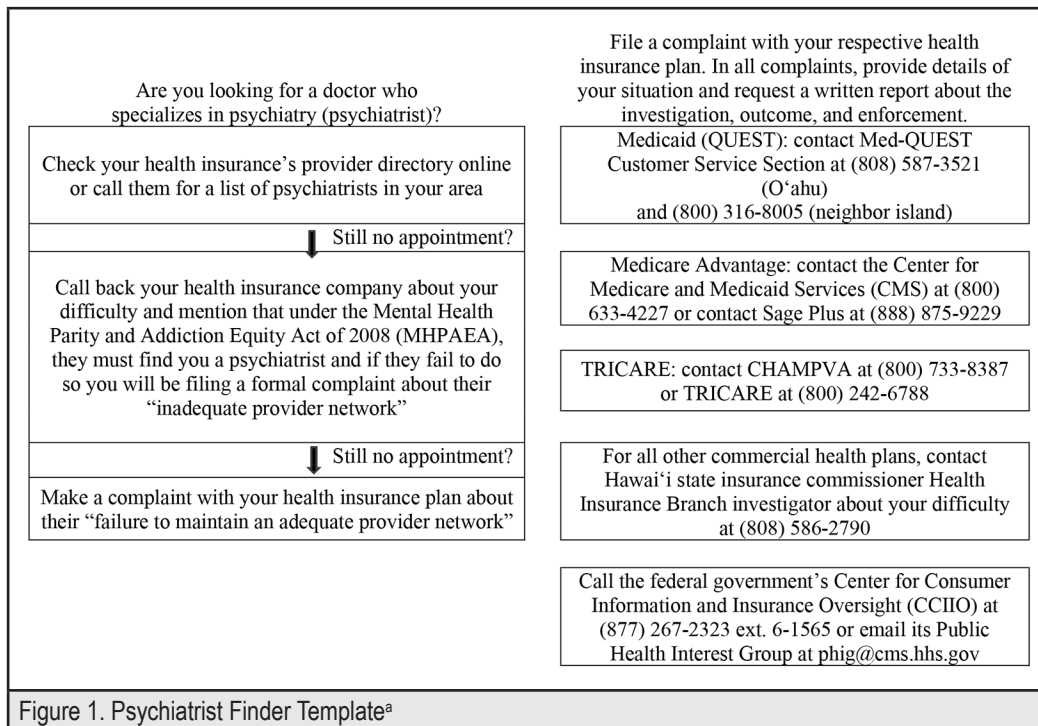


Figure 1. Psychiatrist Finder Template^a

^a Adapted from the Hawai'i Psychiatric Medical Association, Psychiatrist Finder Template.

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Antibiotic Practice Change to Curtail Linezolid Use in Pediatric Hospitalized Patients in Hawai'i with Uncomplicated Skin and Soft Tissue Infections

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Abstract

Antimicrobial resistance affects health care providers' choice of antibiotics in the treatment of skin and soft tissue infections (SSTIs). Based on local antibiotic susceptibility data showing high clindamycin resistance and high MRSA prevalence, a change in antibiotic regimen for children hospitalized for uncomplicated SSTIs was instituted in an attempt to curb the use of linezolid. A retrospective chart review was performed on 278 pediatric patients with uncomplicated SSTIs hospitalized at Kapi'olani Medical Center for Women and Children in Hawai'i from May 2014 to April 2015 and November 2015 to October 2016. Data consisted of 12 months of baseline data and 12 months of data post-implementation of an antibiotic combination regimen of 2 widely-used antibiotics: high-dose cefazolin and high-dose clindamycin. Practitioners were encouraged to use cefazolin alone if clinical suspicion was high for single-organism infection with group A streptococcus. The measured outcomes included initial antibiotic, switch in antibiotic, and length of stay. The use of the combination of cefazolin and clindamycin as the initial treatment, compared with prior practice of monotherapy with clindamycin or cephalosporin, was associated with fewer patients started on linezolid ($P=.03$), no increase in patients switching to linezolid ($P=.97$), and no significant change in length of stay ($P=.06$). When clindamycin resistance and MRSA prevalence are both elevated, the combination of cefazolin and clindamycin is an option that can help with antibiotic stewardship to decrease the use of linezolid.

Keywords

Antibiotic resistance, Hawai'i, Pediatrics, Skin and soft tissue infection, Staphylococcus, Streptococcus

Abbreviations

GAS = group A Streptococcus
MRSA = methicillin-resistant Staphylococcus aureus
MSSA = methicillin-susceptible Staphylococcus aureus
SA = Staphylococcus aureus
SD = standard deviation
SSTI = skin and soft tissue infection

Introduction

Antimicrobial resistance is of increasing global concern. Changes in resistance patterns require adjustments in the choice of antibiotics for a variety of infections, including the treatment of uncomplicated skin and soft tissue infections (SSTI) typically caused by *Staphylococcus aureus* (SA) and group A *Streptococcus* (GAS). The rise in methicillin-resistant *Staphylococcus aureus* (MRSA) between 1990 to 2005 led to MRSA infection becoming more common than methicillin-susceptible *Staphylococcus aureus* (MSSA) infections.¹ For

MRSA coverage, clindamycin became a widely-used antibiotic for treating uncomplicated SSTIs in children. Following increasing clindamycin use, increasing clindamycin resistance was soon noted, particularly in MRSA isolates.² Prior to 2010, MRSA predominance appeared to peak, and since then it has been decreasing.³ The prevalence of clindamycin-resistant GAS has been known to vary with time and location with US rates ranging from 4%-41% since the early 2000s.⁴

In Hawai'i, methicillin and clindamycin resistance patterns of SA initially followed similar increasing trends. Antibiograms at Hawai'i's children's hospital, Kapi'olani Medical Center for Women and Children, showed that MRSA accounted for 23%-31% of SA isolates since 2012, and 27% in 2018. Clindamycin-resistant MRSA reached a peak at 36% in 2014 and decreased to 27% for the past 2 years, and clindamycin-resistant MSSA has fluctuated between 18-26% since 2012, and was 21% in 2018.⁵ Testing of GAS for clindamycin-susceptibility began in 2015 at the hospital; since then, GAS clindamycin-resistance ranged from 3%-14%, and was 10% in 2018.

Vancomycin and linezolid are 2 of the very limited number of antibiotics used to treat clindamycin-resistant MRSA. Both have high costs associated with them, linezolid due to the higher drug cost and vancomycin due to costs for monitoring and administration. Vancomycin is only effective for SSTIs when given intravenously. Linezolid has the added benefit of an oral formulation that has equivalent bioavailability as the intravenous formulation. With increasing use, vancomycin and linezolid resistance have been reported.⁶⁻⁸

Antimicrobial stewardship has become a nationwide mission. Many organizations including the Centers for Medicare and Medicaid Services have rallied to the call for more appropriate use of antimicrobials to decrease the development of multidrug-resistant organisms, which can result in increased morbidity and mortality and increased health care costs. Starting in 2016, Kapi'olani Medical Center for Women and Children began developing its own antimicrobial stewardship program. One focus of this program was also on linezolid.

Prior to 2015, the majority of pediatric patients admitted to Kapi'olani Medical Center for Women and Children for uncomplicated SSTIs were treated with clindamycin alone. In cases of presumed outpatient clindamycin failure, patients were started on vancomycin or linezolid. Linezolid, at times, was preferred due

to concern for difficulties in attaining therapeutic vancomycin levels. Patients who were on vancomycin or linezolid in the hospital and had no positive cultures were typically discharged on oral linezolid. The definition of clindamycin failure was not well-identified and some patients considered to have clindamycin failure had received less than 48 hours of clindamycin. It was hypothesized that some of these presumed failures were due to inadequate duration on clindamycin, clindamycin-resistant GAS, or clindamycin-resistant MSSA infections, and that these “failures” might have been adequately treated with either cefazolin or more clindamycin, and did not require the extended coverage of linezolid or vancomycin.

The Infectious Diseases Society of America’s 2014 SSTI guidelines suggest that clindamycin is an option for mild-moderate non-purulent and severe purulent infections if the clindamycin resistance rate in the community is <10%-15%.⁹ The clindamycin resistance rate at Kapi‘olani Medical Center for Women and Children has been >15% for SA and up to 14% for GAS; therefore, clindamycin is not a useful single agent at this institution. Based on this institution’s pediatric culture data in 2015, focusing only on SA and GAS, it was calculated that use of clindamycin alone would have been inadequate treatment for 24% of culture-positive cases (clindamycin-resistant MSSA/MRSA/GAS), cefazolin alone would have been inadequate treatment for 28% of culture-positive cases (MRSA), and the combination of cefazolin and clindamycin would have missed (been inadequate treatment for) just 9% of culture-positive cases (clindamycin-resistant MRSA). Because the majority of non-purulent, non-culturable cases are more likely to be caused by GAS and less likely by MRSA, cefazolin alone would be an acceptable alternative to the combination for these cases.⁹ Based on these data, it was hypothesized that using a combination of cefazolin and clindamycin or cefazolin alone for non-purulent infections would decrease the use of linezolid and/or vancomycin.

Methods

In mid-2015, staff pediatric hospitalists and pediatric residents were educated about the potential benefits of a new antibiotic regimen consisting of a combination of intravenous cefazolin 100mg/kg/day and intravenous clindamycin 40mg/kg/day (with a dose limit of the maximum adult dose). Education consisted of presenting the local rates of antibiotic resistance, highlighting the ongoing high prevalence of MRSA and clindamycin-resistant SA and GAS, and showing that cefazolin and clindamycin duo therapy would theoretically decrease the amount of inadequately treated infections. Practitioners were also encouraged to use cefazolin alone for non-purulent infections typical of GAS. The local pediatric hospitalist SSTI practice guideline and electronic-medical record SSTI order set were updated to include the new antibiotic combination recommendation. The practice guideline was available for review as a link within the electronic medical record order set. Practitioners were still able

to order vancomycin or linezolid at their discretion. Buy-in was obtained from staff pediatric infectious disease specialists after presentation of the same local antimicrobial resistance data. Practitioners were encouraged to narrow antibiotics based on culture results if available. If cultures were negative or could not be collected, the patients were sent home on cephalexin 100mg/kg/day divided 3 times per day and clindamycin 40mg/kg/day divided 3 times per day. A waiver was granted by the Hawai‘i Pacific Health Institutional Review Board for this project.

A retrospective chart review was performed on patients hospitalized for uncomplicated SSTIs before the educational intervention, from May 2014 to April 2015, and after the educational intervention, from November 2015 to October 2016. Charts were pulled from the electronic medical record for patients age ≤ 18 with the following diagnosis codes: ICD-9 680–686, 709.9, ICD-10 L02.211-9, L02.419, L02.611-9, L03.011-9, L03.031-9, L03.111-9, L03.129, L03.211, L03.221, L03.311-9, L03.811, L03.90, L08.9. Of 483 charts reviewed manually, 205 charts were excluded based on exclusion criteria: a primary diagnosis other than SSTI; complicated SSTIs including osteomyelitis, fasciitis, septic arthritis, or bacteremia; diagnoses that may need alternative or additional antibiotic coverage other than cefazolin and clindamycin including mastoiditis, otitis externa, periorbital/orbital cellulitis, facial cellulitis of dental origin, foot infections, omphalitis, infections sustained in water, infections caused by human or animal bites.

Data were collected on age, sex, diagnosis, type, and timing of antibiotics administered, whether a switch occurred from initial antibiotic to linezolid or vancomycin, length of stay (LOS) calculated from time of first entered vital sign to time of discharge order, and wound and blood cultures. Data were analyzed using Wilcoxon rank sum for continuous variables, and Chi-squared and Fisher’s Exact tests for categorical variables. Statistical analyses were performed by a statistician provided by the Hawai‘i Pacific Health Summer Research Program.

Results

There were no significant differences in age, gender, or culture results between the pre-intervention and post-intervention groups. The mean age of patients was 5.6 years old (Table 1). There was no significant difference in clindamycin-resistance between groups ($P=.54$ and $.92$ for MSSA and MRSA clindamycin-resistance respectively).

There was a significant decrease in the percent of patients started on linezolid or vancomycin within the first 24 hours of admission, from 25% to 13.6% ($P<.05$) (Table 2). Despite fewer cases involving initial linezolid or vancomycin in the post-intervention group, there was no statistically significant change in LOS (Table 3). The raw data showed a non-statistically significant 10.5-hour difference. Secondary data review of patients with prolonged LOS >2 standard deviations (SD) from

mean revealed that some patients had prolonged LOS despite being ready for discharge from an infection standpoint. These patients were not discharged due to inability to adhere to oral antibiotics regimen, inability to perform wound care at home, or hospitalization in the neonatal intensive care unit from birth for reasons unrelated to SSTIs and for which SSTIs did not affect LOS. Recalculation of LOS without these patients showed a smaller 7-hour difference: The average pre-intervention LOS was 71.7 hours and the post-intervention LOS was 78.8 hours.

There was no significant difference between the pre- and post-intervention periods in the number of patients switched to linezolid or vancomycin (Table 2). Despite fewer patients started on linezolid or vancomycin in the post-intervention group, there was not a higher percentage of patients who were switched to linezolid or vancomycin later.

The incidence of positive blood cultures was <2% in both groups and not statistically significant between the groups (Table 4).

Variable	mean ± SD (range) or n (%)			P-value	P-value using Kruskal-Wallis test
	Total (n=278)	Pre (n=160)	Post (n=118)		
Age (years)	5.6 ± 5.6 (0 - 17)	5.6 ± 5.6 (0 - 17)	5.6 ± 5.6 (0 - 17)	.97	.83
Female	131 (47.1%)	73 (45.6%)	58 (49.2%)	.64	

Variable	Number of patients (%)			P-value
	Total (n=278)	Pre-intervention (n=160)	Post-intervention (n=118)	
Initial Linezolid/Vancomycin First 24hrs	56 (20.1%)	40 (25%)	16 (13.6%)	.03
Cefazolin	127 (45.7%)	25 (15.6%)	102 (86.4%)	<.0001
Clindamycin	242 (87.1%)	135 (84.4%)	107 (90.7%)	.17
Linezolid	56 (20.1%)	39 (24.4%)	17 (14.4%)	.06
Vancomycin	17 (6.1%)	6 (3.8%)	11 (9.3%)	.10
Switch to linezolid or vancomycin	48 (17.3%)	27 (16.9%)	21 (17.8%)	.97
GAS clindamycin-susceptible	67	38	29	.10
GAS clindamycin-resistant	5	4	1	.57
MSSA clindamycin-susceptible	61	42	19	.06
MSSA clindamycin-resistant	15	7	8	.54
MRSA clindamycin-susceptible	33	17	16	.58
MRSA clindamycin-resistant	11	7	4	.92

Variable	mean ± SD (range) or n (%)			P-value	P-value using Kruskal-Wallis test
	Total (n=278)	Pre-intervention (n=160)	Post-intervention (n=118)		
Length of stay (days)	79.1 ± 44.8 (14 - 294)	74.64 ± 41.35 (14 - 277)	85.1 ± 48.6 (19 - 294)	.06	.06

Variable	Number of patients (%)			P-value
	Total (n=278)	Pre (n=160)	Post (n=118)	
Wound culture, none	88 (31.7%)	48 (30%)	40 (33.9%)	.58
Blood culture positive	4 (1.4%)	3 (1.9%)	1 (0.9%)	.84
Blood culture, none	55 (19.8%)	27 (16.9%)	21 (17.8%)	.97

Discussion

Current national guidelines recommend monotherapy for uncomplicated SSTIs, however, Kapi'olani Medical Center for Women and Children's experience with monotherapy, with high local rates of MRSA and high clindamycin-resistance of SA and GAS, had led to increased use of linezolid due to treatment failures. This project utilized 2 commonly used antibiotics, cefazolin and clindamycin, which, when used separately as monotherapy, have become ineffective due to increased local antibiotic resistance. However, the data collected in this project suggest the combination of these antibiotics has the potential to decrease use of linezolid, a broader-spectrum antibiotic, which in turn may decrease the risk for development of linezolid-resistant organisms. Decreased initiation of linezolid on admission reassuringly did not adversely affect LOS or increase the use of linezolid after the first 24 hours of hospitalization.

Limitations of this study include a small sample size and potential to affect patient compliance given the potential need to take 2 antibiotics at home in cases that do not allow for narrowing antibiotics. Dividing both cephalexin and clindamycin into 3 times per day dosing allows parents to administer both medications at the same time at flexible times, eg, "in the morning," "after school," and "before bedtime," which may help with adherence.

Clindamycin resistance in SA appears to continue to rise in other parts of the United States, but there appears to have been no significant change in clindamycin resistance in Hawai'i between 2016 and 2018.¹⁰ It is not possible to determine at this time if this difference is due to antibiotic selection, coincidence, or other concurrent interventions such as the creation of an antimicrobial stewardship program. Future studies could include collecting larger sample sizes by analyzing longer time periods and assessing antimicrobial resistance rates on this regimen for a longer period of time.

Combination therapy with cefazolin and clindamycin is a potential option in areas of high clindamycin resistance and high MRSA prevalence and may lead to decreased need for broader MRSA coverage with linezolid.

Conflict of Interest

The authors report no conflicts of interest.

Acknowledgements

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A Comparison of Length of Hospitalization and Costs in Obese and Non-Obese Pediatric Patients at a Single Hospital in Honolulu

Kara Wong Ramsey MD; James Davis PhD; and May Okihiro MD

Abstract

The association of obesity with increased hospital costs and length of stay among hospitalized pediatric patients identified by ICD-9 coding may be underestimated due to underreporting of appropriate ICD-9 coding for obesity status. The objective of this study was to compare these lengths of stay and hospital costs. A retrospective chart review was conducted of pediatric patients admitted from May 2009 to January 2012 at Kapi'olani Medical Center, Honolulu, Hawai'i, with the 20 most common primary admission diagnosis ICD-9 codes. Length of hospital stay and total hospital costs were compared for obese, overweight, and normal-weight patients based on body mass index (BMI), controlling for age, sex, ethnicity, insurance type, diagnosis, and calendar year using logistic regression. Analysis of 730 patients showed 1% of overweight patients and 35% of obese patients were correctly coded with the corresponding ICD-9 code for weight status. Obese patients had 15% longer hospital stays and 19% higher hospital costs than normal weight patients, when controlled for age, sex, ethnicity, insurance type, calendar year, and primary diagnosis. Subgroup analyses of the top 3 most common primary admission diagnoses showed obese patients with asthma had significantly higher hospital costs than normal weight patients. Obesity is an independent risk factor for increasing hospital resource utilization in hospitalized pediatric patients. Documentation of ICD-9 codes for overweight and obesity in this cohort drastically underrepresented the true prevalence of obesity and overweight status in this sample of hospitalized children. Further research is needed to better understand the complex role of obesity in pediatric inpatients, particularly among those with asthma.

Keywords

asthma, BMI, hospital cost, length of stay, pediatric obesity

Abbreviations

BMI = body mass index

CDC = Centers for Disease Control and Prevention

CI = confidence interval

ICD-9 = International Classification of Diseases-9th Edition

KMCWC = Kapi'olani Medical Center for Women and Children

Introduction

The overall prevalence of obesity in United States (US) children aged 2 through 19 has increased since the 1980s from 10% to 17% in 2011-2014.¹ The burden of disease from obesity and its associated co-morbidities resulting in increasing health care costs has become a growing national concern. Two large studies of children 2-17 years of age found a positive correlation between childhood obesity and the number of hospitalizations which included obesity as a discharge diagnosis, as well as higher total costs for these hospitalizations.^{2,3} Another study

examining the 2002-2005 Medical Expenditure Panel Survey found that obese and overweight children aged 6-19 years old generated more outpatient visits, more prescription drugs, and greater emergency room expenditures, especially among adolescents. Nationally, these additional expenditures represent an increase of \$14.1 billion spent annually in the US health care system.⁴ Several other studies utilizing large national databases of hospitalized pediatric patients have also found an association between obesity and longer hospital stays and higher hospital costs.⁵⁻⁷

However, despite the statistical strength of these large studies, each relied solely on International Classification of Diseases, Ninth Edition (ICD-9) coding to identify overweight and obese subjects rather than body mass index (BMI) calculations. These studies may have underestimated the extent of the association between overweight and obesity and medical resources cost and utilization. One study showed that of 20.4% of hospitalized children meeting BMI-based obesity criteria, only 1.7% had the obesity ICD-9 code listed among their discharge diagnoses.⁸ There are a few smaller pediatric studies that have examined hospital outcomes using BMI, rather than ICD-9 coding, to categorize patient body composition but these studies looked at only specific admission diagnoses such as burn injuries, asthma, or H1N1 influenza. Overall, they found that obese children tended to have longer hospital stays and require more intensive care or treatment.⁹⁻¹² In addition, studies on the relationship between obesity and hospital resource utilization are sparse in disadvantaged ethnic minority groups where the prevalence of overweight and obesity may be higher than in the general population, such as among Pacific Islander youth. The racial composition of Hawai'i's population is unique as compared to other US states, with 21% identifying as at least part Native Hawaiian, 48% as Asian, and 4% as Other Pacific Islander, according to 2010 state census data.¹³

The objective of this study was to retrospectively examine the impact of obesity on hospital costs and length of stay in pediatric patients in a predominantly Asian and Pacific Islander population, utilizing BMI to identify obesity status.

Methods

This was a retrospective cross-sectional chart review study of pediatric admissions between May 1, 2009 and January 31, 2012 conducted at Kapi'olani Medical Center for Women and Children (KMCWC), Honolulu, Hawai'i. KMCWC is the only

children's hospital in the state of Hawai'i and admits children and adolescents who require specialized pediatric care from all islands of Hawai'i as well as Pacific nations. Hospitalization data for patients ages 2-18 years admitted to the general pediatric ward, from the island of O'ahu, the most populated island of Hawai'i, were reviewed. Each patient was assigned a single primary admission diagnostic ICD-9 code by the treating clinician to indicate the primary reason for the patient's admission. Additional secondary ICD-9 codes were selected by the clinician to indicate the patient's other medical problems, such as obesity, if applicable. Research subjects were identified and selected based on having 1 of the 20 most common ICD-9 primary admission diagnostic codes during the study period. To simplify and strengthen the analysis of data in this study, similar diagnoses were consolidated and some of the primary admission diagnostics categories were combined into more generalized ones when appropriate. For example, *cellulitis of the leg* was combined with *cellulitis of the arm* to create 1 *cellulitis* category. This process resulted in the consolidation of the original 20 diagnostic groups into 9. These included asthma, cellulitis, pneumonia, dehydration, seizures, Kawasaki disease, meningitis, diabetic ketoacidosis, and appendicitis. Pediatric admissions were excluded if BMI data were missing. Patients with secondary ICD-9 codes indicating complex medical conditions, such as cerebral palsy, G-tube dependency, and congenital heart disease, were also excluded because these conditions were more likely to lead independently to higher hospital costs and longer lengths of stay. Patients with non-O'ahu residential zip codes were excluded, as patients transferred from other islands may represent patients with higher acuity of illness which local referring hospitals were unable to manage.

BMI was calculated in children 2 years and older as weight (in kilograms) divided by height (in meters) squared based on the weight and height measurement taken on admission by nursing personnel. BMI was converted automatically into percentiles for age and sex, based on standard Centers for Disease Control and Prevention (CDC) growth charts, by the hospital electronic medical record system. Children 2 years and older were defined as underweight if their BMI was <5th percentile, overweight if their BMI was \geq 85th percentile but <95th percentile, and obese if BMI was \geq 95th percentile; children were considered normal weight if they did not fall into any of these categories, according to definitions of childhood obesity established by the CDC.

For analyses, age in months, length of stay, and total hospital costs were treated as continuous variables. Costs were controlled for calendar year. Other variables were analyzed after classification into categories. Insurance type was categorized as private insurance, Medicaid, or no insurance. Residence, based on zip codes from hospital registration, was categorized into those living in Honolulu and those living outside the city of Honolulu. Ethnicity was based on the ethnicity reported by the patient's parents at hospital registration.

Statistical Analysis

This study compared the length of hospital stay and total hospital costs across the 4 BMI groups while controlling for age, sex, residency, primary diagnosis, Honolulu residency, and insurance type, using quantile regression analysis with results calculated as median differences. SAS Version 9.4 (SAS Institute Inc., Cary, NC) was the statistical program used for analysis.

This research study was reviewed by the Hawai'i Pacific Health Research Institute and found to be exempt from Institutional Review Board Review (Hawai'i Pacific Health Research Institute Study Number 2010-145).

Results

A total of 1601 pediatric patients ages 2-18 were admitted during the study period with the 9 reformulated diagnostic categories listed above. The 3 most common diagnoses were asthma, cellulitis, and pneumonia. After applying exclusion criteria (there were 350 charts with missing BMI data, 341 charts with complex medical conditions, and 180 charts with non-O'ahu residential zip codes), 730 subjects remained eligible for analysis.

Of the subjects, 57% were male and 43% were female; 52% had Medicaid insurance, 48% had private insurance, and none were uninsured. The majority of children were young: 57% were 2-5 years of age, 20% were 6-9, 11% were 10-12, and 13% were 13-17 years of age. Based on parent-reported ethnicity, 15% of included patients were Asian (including Chinese, Korean, Japanese, Laotian), 13% were Filipino, 22% were Hawaiian or part Hawaiian, 9% were Other Pacific Islander (including Tongan, Marshallese, and Micronesian), 11% were Samoan, and 12% were Caucasian, with 20% reporting no ethnicity. The authors chose to analyze Filipinos, Hawaiians, and Samoans as separate categories from other Asians and Other Pacific Islanders because these ethnic groups made up large proportions of the study cohort (Table 1).

Based on calculated BMI on admission, 11% of the subjects were underweight, 59% were normal weight, 12% were overweight, and 18% were obese. Only 34.6% of obese patients and 1% of overweight patients were coded with the corresponding ICD-9 code for weight status. Obesity prevalence was higher among Samoans (45%), Hawaiians (21%), and Filipinos (14%) compared to Other Pacific Islanders (11%), Caucasians (8%), and Asians (5%). Prevalence of Medicaid insurance was higher among Pacific Islanders (92%), Samoans (78%), and Hawaiians (52%) as compared to Filipinos (44%), Caucasians (36%), and Asians (26%). Neither length of stay nor total hospital costs differed significantly by ethnicity.

Most hospital stays were short: the 25th percentile was 1 day, the median (50th percentile) was 2 days, and the 75th percentile

Table 1. Patient Demographics	
N=730	
Weight Category	
Underweight (BMI < 5th percentile)	78 (11%)
Normal weight (BMI 5th to 84th percentile)	432 (59%)
Overweight (BMI 85th to 95th percentile)	90 (12%)
Obese (BMI ≥ 95th percentile)	130 (18%)
Sex	
Male	414 (57%)
Female	316 (43%)
Age	
2-5 years	413 (57%)
6-9 years	144 (20%)
10-12 years	81 (11%)
13-17 years	92 (13%)
Insurance Type	
Medicaid	376 (52%)
Private Insurance	354 (48%)
Ethnicity	
Asian	107 (15%)
Filipino	95 (13%)
Hawaiian or Part Hawaiian	159 (22%)
Samoan	77 (11%)
Other Pacific Islander	64 (9%)
Caucasian	85 (12%)
Other	88 (12%)
Not reported	55 (8%)
Primary Diagnosis	
Asthma	200 (27%)
Pneumonia	136 (19%)
Cellulitis	121 (17%)
Dehydration	90 (12%)
Appendicitis	59 (8%)
Kawasaki disease	49 (7%)
Seizures	30 (4%)
Diabetic ketoacidosis	23 (3%)
Meningitis	22 (3%)

A total of 730 patients were identified who met the study inclusion criteria and who were admitted under the top 9 primary diagnoses. Each patient was identified with a single primary diagnosis. Demographic information on the BMI weight category, sex, age, insurance type, ethnicity, and primary diagnosis are shown here.

was 2 days, since a majority of the patients only had a hospital stay of 2 days. The median (50th percentile) total hospital cost was \$9392. The 25th percentile of total hospital cost was \$6275 and the 75th percentile was \$14 767.

Compared to normal-weight patients, obese patients had a 15% longer length of stay (95% CI, 1%-30%), controlling for age, sex, Honolulu residency, primary diagnosis, and insurance type (Table 2). Hospital costs for obese patients were 19% higher than those for normal-weight patients (95% CI, 7%-31%). This represented higher hospital costs of \$1015 for obese patients compared to normal-weight patients (95% CI, \$144-\$1895). No significant differences in lengths of stay or total hospital costs were found between overweight or underweight patients compared to normal-weight patients.

In a separate analysis of the top 3 admission diagnoses (asthma, cellulitis, and pneumonia), utilizing individual quantile regression analysis while controlling for demographic variables and calendar year, obese patients had 36% higher total hospital costs compared to normal-weight patients with asthma. There was a non-significant trend towards higher hospital costs for obese patients compared to normal weight patients with cellulitis. There was a non-significant trend towards longer length of stay for obese patients compared to normal-weight patients with asthma or cellulitis (Table 3).

Table 2. Length of Stay and Total Hospital Costs in Underweight, Overweight, and Obese Patients Compared to Normal-Weight Patients

BMI Weight category	Difference in length of stay compared to normal-weight patients			Difference in total hospital costs compared to normal weight patients*		
	% Difference	95% CI	P-value	% Difference	95% CI	P-value
Underweight	-3	-21-16	.77	-3	-17-11	.63
Overweight	-1	-17-16	.94	-0.4	-14-13	.95
Obese	15	1-30	.04	19	7-31	<.01

Age, sex, primary diagnosis, Honolulu residency, and insurance type were controlled. Obese patients had a statistically significant 15% longer length of stay and statistically significant 19% higher total hospital costs compared to normal-weight patients. No significant difference in length of hospital stay or total hospital costs were found for overweight and underweight patients compared to normal-weight patients. Costs indicators were adjusted for calendar year.

Table 3. Length of Stay and Total Hospital Costs in Underweight, Overweight, and Obese Patients Compared to Normal-Weight Patients Admitted Under the Top 3 Admission Diagnoses

Primary Diagnosis	Difference in hospital length of stay compared to normal-weight patients			Difference in total hospital costs compared to normal-weight patients		
	% Difference	95% CI	P-value	% Difference	95% CI	P-value
Asthma						
Underweight	-4	-37% - 30%	.82	-3	-27% - 21%	.79
Overweight	-8	-42% - 27%	.67	-5	-31% - 20%	.68
Obese	18	-10% - 46%	.21	36	13% - 59%	<.01
Cellulitis						
Underweight	37	-13% - 86%	.15	38	-8% - 83%	.11
Overweight	4	-30% - 37%	.82	1	-27% - 29%	.96
Obese	26	-1% - 54%	.06	15	-9% - 40%	.23
Pneumonia						
Underweight	-27	-76% - 22%	.29	-17	-58% - 24%	.43
Overweight	-37	-81% - 8%	.11	-14	-51% - 23%	.45
Obese	-25	-67% - 17%	.24	-31	-68% - 5%	.09

Age, sex, primary diagnosis, Honolulu residency, and insurance type were controlled. Obese patients had 36% higher total hospital costs compared to normal-weight patients with asthma. There was a non-significant trend towards higher hospital costs for obese patients compared to normal weight patients with cellulitis. There was a non-significant trend towards longer length of stay for obese patients compared to normal-weight patients with asthma or cellulitis.

Discussion

As shown in previous studies, ICD-9 codes for obesity and overweight were underreported for patients with above normal BMI; the charts for only 1% of overweight patients and 35% of obese patients were coded with the corresponding ICD-9 code for weight status. Furthermore, 22% of charts in the initial study sample were excluded due to missing BMI data, mainly because patients' heights were not recorded in the medical chart. Height may be omitted due to a patient's clinical instability, uncooperative behavior, or oversight by medical staff. Additional investigation is needed to explore ways to improve documentation of pediatric admission height. Nevertheless, even when BMI data were available in the chart, a majority of patients who met the definition of obesity or overweight based on BMI did not have the corresponding ICD-9 code entered in the chart. Omission of the appropriate ICD-9 codes may represent a failure of the treating clinician to recognize that the patient's BMI meets the definition of obesity or overweight, or the clinician may feel that obesity or overweight status does not constitute a medical problem to be addressed during the hospital stay. Further research is needed to identify strategies to improve compliance with accurately recording ICD-9 code for pediatric obesity or overweight status. Improved utilization of ICD-9 codes will lead to more accurate reporting of the true prevalence of pediatric obesity in hospitalized patients and improved interpretation of studies based on large databases built from medical chart records and ICD-9 coding.

In this study, obese patients had statistically significant longer lengths of stay. However, given the overall short duration of

lengths of stay (with median and 75th percentile both equal to 2 days), the clinical impact of this finding is likely negligible. However, the data also showed that obese patients had significantly higher hospital costs compared to non-obese patients for their overall hospital stay. Further analysis examining differences between obese and non-obese patients with the top 3 admission diagnoses (asthma, cellulitis, and pneumonia) found significantly higher hospital costs only for obese patients with asthma, suggesting that obesity may play a greater role in the hospitalization costs for certain primary diagnoses.

Obesity may predispose patients to metabolic, physiological, and anatomical alterations that may make obese patients more susceptible to asthma complications and lead to higher hospital costs. Obesity may adversely affect pulmonary mechanics and impede recovery from an asthma exacerbation. Studies have shown that patients with metabolic syndrome or increased abdominal obesity were more likely to have impaired forced expiratory volume and lower functional residual capacity.^{14,15} Obesity produces metabolic alterations leading to an inflammatory state that may promote asthma related physiological changes. Elevated leptin levels in obese children with asthma compared to non-obese children with asthma promotes a higher T-helper cells-1/T-helper cells-2 ratio, an inflammatory pattern associated with lower airway obstruction and bronchoconstriction.¹⁶ Obese children are at greater risk for developing asthma compared to non-obese children.¹⁷ Moreover, reports suggest that asthma is more severe among obese children.^{18,19}

Similar to other studies in Hawai'i, this study documented a higher prevalence of obesity among Samoans and Native

Hawaiians as compared to other ethnic groups. Despite higher percentages of Asians and Pacific Islanders in the sample compared to the continental US, the overall prevalence of obesity (18%) and overweight (12%) as determined by BMI in our hospital study population in Hawai'i was similar to pediatric data reported nationally.¹ In the national data, Asian and Pacific Islander groups are often categorized together as a single group, thus the higher rates of obesity among Pacific islanders ethnic groups (20-45% in our sample) may be offset by the lower rates of obesity among Asians (5% in our sample).

There are several limitations to our study. The sample is limited to patients at 1 hospital, hospitalized over a 32-month period. Because patients from non-O'ahu zip codes and those with complex medical conditions were excluded, a majority of the study patients (54% of our initial sample) was excluded from analysis, which may limit the clinical utility of the data. The data were limited to computer extraction of the medical records based on our inclusion criteria for BMI, zip codes, and admission diagnoses. Individual chart review to explore other potential reasons for prolonged hospital stays or costs was not performed, ICD-9 diagnoses codes may not capture issues such as poor medical follow up care, limited family resources, or more severe initial hospital presentation. Length of stay was calculated based on only admission and discharge dates. Individual chart review was not performed to look at hours of hospital stay for a more detailed analysis. Age was not controlled in the regression analysis, and a large portion of the patients (57%) were very young, aged 2-5 years, which may make these findings less applicable to older patients.

While the results of this study are consistent with others demonstrating an association between obesity and increased hospital length of stay and greater hospital costs, causality remains unclear. Severity of disease, demographics, and hospital factors need to be considered and analyzed in a more comprehensive analysis. Until utilization of ICD-9 codes for pediatric obesity and overweight status can be improved, future prospective studies of hospitalized children obese children as identified by measured by BMI rather than ICD-9 codes are needed to explore the complex interplay involved in the association between obesity and increased hospital resource utilization. In particular, studies exploring the association between obesity and asthma may identify more prospective targets for obesity and asthma-related patient interventions.

Conflict of Interest

None of the authors identify any conflicts of interest.

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A Qualitative Evaluation of the Impacts of a Strength-based and Youth-driven Approach to Suicide Prevention in Rural and Minority Communities in Hawai'i

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Abstract

Suicide is a serious public health issue, particularly for Native Hawaiians and Other Pacific Islander youth living in rural communities in Hawai'i. The Hawai'i's Caring Communities Initiative (HCCI) for Youth Suicide Prevention was implemented to address these concerns and used a strength-based, youth-leadership approach to suicide prevention. A qualitative study was completed with youth leaders and adult community coordinators to evaluate the impacts of participating in HCCI. Participants included 9 adult community coordinators and 17 youth leaders ages 13-18 years. Coordinator interviews took place at a location of the interviewee's convenience, and youth leader focus groups were conducted at 1 of 6 rurally-based community organizations. A team of university staff members coded transcripts using a narrative approach and grouped codes into themes. Five themes emerged that fit with an adapted socio-ecological model framework, which included increased knowledge in suicide risk, pride in leadership identity, sense of positive relationships, positive affirmation from community members, and sustainability. Future efforts that focus on youth-related issues are encouraged to integrate a youth leadership model and preventive approach while considering implications such as long-term funding and capitalizing on community strengths and resources.

Keywords

Native Hawaiian and Other Pacific Islander, socio-ecological model, suicide prevention, youth

Abbreviations

*HCCI = Hawai'i's Caring Communities Initiative for Youth Suicide Prevention
NHOPI = Native Hawaiian and Other Pacific Islander
SAMHSA = Substance Abuse and Mental Health Services Administration
SEM = socio-ecological model*

Introduction

Suicide is a serious public health concern. In the United States, suicide is the second leading cause of death for individuals 10-24 years.¹⁻² Youth suicide prevention strategies have been implemented in various communities and schools to address concerns related to suicide.²⁻⁴ Yet studies evaluating the outcomes and impact of suicide prevention programs have generally focused on individual-level changes, such as gatekeepers' or individual participants' increased knowledge of suicide prevention and perceived preparedness to help individuals in distress.⁵⁻⁶ Limited research has examined youth-led suicide prevention programs and their potential impacts, and even fewer have evaluated the impacts of suicide prevention programs on multiple levels.⁷⁻⁸

In Hawai'i, suicide is the second leading cause of death for individuals ages 10-34 years⁹ and the leading cause of injury-related deaths.¹⁰ Youth living in rural communities, and especially Native Hawaiians and Other Pacific Islanders (NHOPI), are at greater risk of suicide.¹¹ This disparity has been observed in other Indigenous communities and may be attributed to historical trauma and structural inequalities stemming from colonization.¹² Despite these disparities, strengths persist in Native Hawaiian communities. For instance, many Native Hawaiian youth report receiving a large amount of emotional and moral support from community members.¹³

The Hawai'i's Caring Communities Initiative (HCCI) for Youth Suicide Prevention was created to prevent youth suicide and increase early intervention by engaging youth leaders, community members, and health professionals in Hawai'i.¹⁴⁻¹⁶ Partnerships were developed between the University of Hawai'i Department of Psychiatry, the Prevent Suicide Hawai'i Task Force, and 6 rurally-based organizations that serve NHOPI youth.¹⁵ HCCI community coordinators were hired in each of the 6 organizations and were responsible for recruiting, training, and facilitating youth leadership groups in their communities. Community coordinators and youth leaders were certified as Connect trainers.^{7,20} Connect is an evidence-based training program that trains gatekeepers on how to respond to youth who exhibit early warning signs of suicide, decrease stigma surrounding suicide and mental health, increase knowledge of suicide prevention, and increase awareness of community resources.¹⁷ In collaboration with HCCI stakeholders, Connect was culturally tailored.^{7,18} Community coordinators and youth leaders also organized events, activities, and campaigns in their respective communities to promote community awareness of suicide prevention and resources.

HCCI used a youth leadership model that focused on 4 components of prevention: youth empowerment, relationship and team-building activities, suicide prevention training, and community awareness events.¹⁶ The youth leaders were also trained in safe messaging guidelines,¹⁹ which is an evidence-based suicide prevention strategy that focuses on producing public messages about suicide in a way that is unlikely to increase risk of suicidality for vulnerable individuals.²⁰ The purpose of this study was to evaluate the impacts of the HCCI program based on qualitative data from youth leaders and HCCI community coordinators.

Methods

Participants

Nine adult community coordinators and more than 100 youth leaders participated in HCCI over 4 years. All 9 coordinators were interviewed for this study. Three were male, 6 were female, and the majority were NHOPI. A total of 17 youth leaders (ages 13-18) participated in focus groups that occurred at 4 community organizations. Youth who participated in the focus groups were predominantly male, and the majority were NHOPI.

Measures

Semi-structured guides were developed for coordinator interviews and youth leader focus groups. The questions for the coordinator interviews included, “Were there any benefits you experienced from being an HCCI community coordinator?” Some of the questions for the focus groups included, “What have you learned throughout your experience?” and “How has your family or community responded to your involvement in this youth group?”

Procedures

At the start of HCCI, coordinators completed written consent forms and youth leaders submitted youth assent forms and parental consent forms to participate in ongoing evaluation activities of HCCI. Prior to the interviews and focus groups, coordinators were orally re-consented and youth leaders re-consented by re-signing youth assent forms. Coordinator interviews lasted 60-90 minutes at a location of the coordinator’s convenience.

Youth leader focus groups took approximately 60 minutes and were conducted at the community organization’s site. Interviews and focus groups were conducted by HCCI staff members. This study was approved by the University of Hawai‘i’s Institutional Review Board (CHS #19411).

Data Management and Analysis

Interviews and focus groups were audio recorded, transcribed verbatim, and verified by HCCI staff members. Data were analyzed using NVivo Version 11 (QSR International: Burlington, MA).²¹⁻²² The research team used a narrative approach to analyze data. To ensure reliability, HCCI staff members collectively coded 1 of the youth focus groups using consensus coding to create the codebook. HCCI staff members worked in pairs to independently code the remaining interviews and focus groups. If coding pairs disagreed, a third researcher was consulted to achieve consensus among the group.

Results

Five program impact themes were identified. The themes aligned with an adapted socio-ecological model (SEM), which was modified into the following levels: (1) the individual level, ie, coordinators and youth leaders; (2) the interpersonal level, ie, peers and families of the youth leaders and community coordinators; and (3) the community level, ie, broader community, recipients of the gatekeeper trainings and community awareness activities (Figure 1). Table 1 provides the major themes and level of impact according to the adapted SEM, codebook definition, and an example of each theme.

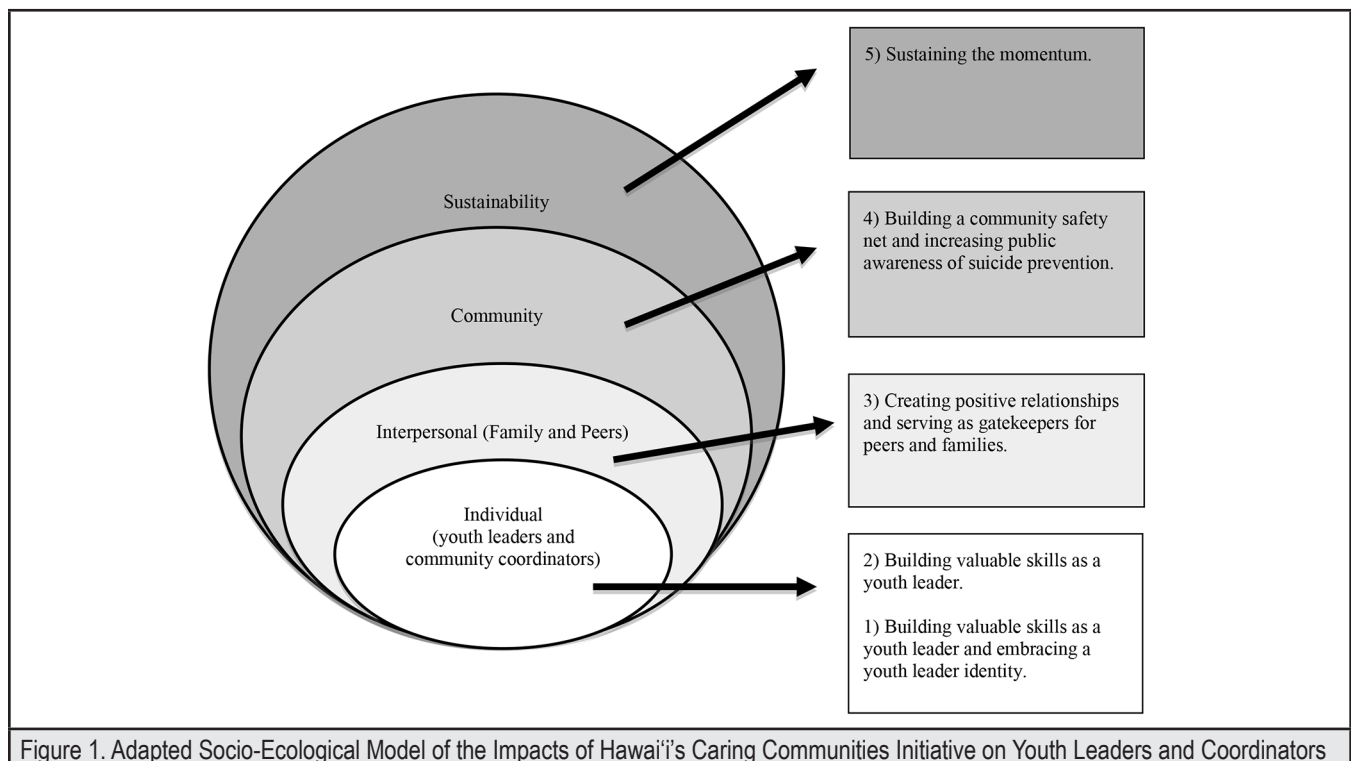


Figure 1. Adapted Socio-Ecological Model of the Impacts of Hawai‘i’s Caring Communities Initiative on Youth Leaders and Coordinators

Table 1. Summary of Themes		
Theme	Codebook Definition	Examples (Quotes)
1: Youth leaders building valuable skills and embracing a youth leader identity Individual Level	Code when interviewee refers to 1 of the following: 1. Increased understanding of suicide prevention and community resources through adaptive youth-friendly training 2. Serving as gatekeepers and developing protocols to connect peers to community resources and trusted adults during times of crisis 3. Increased skills in public speaking and team work 4. Building confidence and important life skills and pride in making a difference 5. Seeing the work of being a youth leader pay off while having fun	"My other friend who is also in this group was talking to a boy on Facebook and he admitted that he had thoughts about doing suicide, so she messaged him, and she had the protocols. The first step is always asking, 'Are you thinking about doing suicide?' And then he said, 'Yes.' so she went on to the next step, which was 'Do you already have a plan?' and he said, 'No.' So if they say "no," you just try to talk to them and get them to feel comfortable enough to explain their situation and then if they're comfortable, try to connect them. And so that's what she did." -Youth Leader, Focus Group
2: Community Coordinators building valuable skills Individual Level	Code when interviewee refers to 1 of the following: 1. Increased understanding and comfort with suicide prevention 2. Increased skills in public speaking 3. Learning valuable skills for career development including community mobilization and working with youth	"For me, of course it's being from a generation where it's kind of taboo to talk about it [suicide]. I never really had a sit-down talk about suicide prevention ever or just about the topic of suicide...I didn't know why people would be at risk of suicide until now. So, it benefited me a great deal, knowing all of the risk factors and warning signs, I didn't know that. And then ways of how-to safe message, that's another one I didn't know - and self-care." -Adult Coordinator, Key Informant Interview
3: Creating positive relationships and serving as gatekeepers for peers and families Interpersonal Level	Code when interviewee refers to 1 of the following: 1. Enhanced relationships among youth leaders, community coordinators, trusted adults, and community resources 2. Youth leaders and coordinators serving as connectors and resources for peers and family members	"I liked that we all had fun but at the same time, we're learning things about suicide and how to help prevent it. Some of the people in our group didn't really talk to each other, and a while after that, we got closer - we bonded." -Youth Leader, Focus Group
4: Building a community safety net and increasing public awareness of suicide prevention Community Level	Code when interviewee refers to 1 of the following: 1. Creating a safety net for suicide prevention 2. Increased awareness of suicide in a safe way in the schools and community 3. Community recognition of the youth leader group 4. Addressing the stigma through a prevention framework	"The kids were always open to spread the word, which is good because if it's coming from them, the parents, the adults, the people in the community would listen. It was good to talk about it and bringing the issues up in the community that we can talk about it and that there's help, local help and national help, but overall local help that you can get. And it's not a bad thing to get help. And also, just talking about suicide in general to the whole public. It helped the community a lot I think." -Adult Coordinator, Key Informant Interview
5: Sustaining the momentum Sustainability	Code when interviewee refers to 1 of the following: 1. Importance of engaging and partnering with schools and organizations 2. Limitations related to limited involvement of the organization, limited time, competing demands or priorities, and limited staffing support 3. Sustaining efforts and learning from the implementation and process of this project	"Overall I have to say the administration [is] extremely supportive. They do try to be community-based as much as possible. They took it a step further than what we were expecting, but it was a positive one. The director made the decision to incorporate it into their curriculum" -Adult Coordinator, Key Informant Interview

Individual Level: Youth leaders and community coordinators

Theme 1: Youth leaders gained valuable skills and embraced a youth leader identity. According to youth leaders, HCCI helped youth develop valuable skills related to suicide prevention and leadership. The increased knowledge and awareness of suicide prevention was primarily attributed to the youth-focused version of the Connect training. Youth shared stories of how their training helped them become gatekeepers in their schools and communities. Youth leaders assisted in the assessment of crisis situations, conveyed the severity of suicide risk to a trusted adult, and identified community resources with community coordinators and trusted adults. Community coordinators validated the development of valuable skills among youth leaders and referred to youth leaders as the “eyes and ears” of their peers and community.

Youth leaders identified gaining empathy, creativity, and networking skills as a result of their participation in HCCI. Youth leaders also described increased leadership skills and starting to see themselves as leaders. The most common leadership skills included taking on initiatives, fulfilling responsibilities, and learning to manage time. The majority of youth also indicated increased pride in making a difference in their community and growing confidence to take on other leadership roles. The community coordinators also confirmed witnessing this youth development throughout the program.

Theme 2: Community coordinators built valuable skills. Community coordinators also reported gaining valuable career development skills. They discussed how their understanding and comfort with the topic of suicide prevention increased. All coordinators reported increased knowledge of utilizing effec-

tive strategies to initiate conversations about suicide and raise awareness of suicide prevention. Coordinators also reported enhancing their public speaking skills and community and youth organizing skills by serving as trusted adults for youth leaders while guiding them in coordinating the suicide prevention events. Although the overall focus of HCCI was suicide prevention, coordinators noted the ability to apply the prevention framework in which they were trained to other sensitive health topics, such as child abuse.

Interpersonal Level: Family and Peers

Theme 3: Creating positive relationships and serving as gatekeepers for peers and families. A common theme was the creation of positive relationships among the HCCI youth leaders and community coordinators. HCCI provided opportunities for youth to create positive relationships with each other, community coordinators, other trusted adults, and the larger community. HCCI brought together a diverse group of youth with a shared purpose to address the issue of suicide in their communities. Many of the organizations recruited youth leaders from various social groups who minimally interacted before joining the group. Youth leaders were able to create friendships and bonds while addressing difficult emotions in a shared safe space. Youth leaders also explained that participating in HCCI enhanced their relationships with peers and family members because the leaders were recognized for the positive impacts they were making in their communities. For instance, youth leaders reported that their friends or classmates sought them out if they were in crisis. Similarly, youth leaders and community coordinators reported that family members began to recognize youth leaders and community coordinators as resources in the community with knowledge about suicide prevention. As a result, family members initiated discussions about suicide and mental health with youth leaders and community coordinators.

Community Level

Theme 4: Building a community safety net and increasing public awareness of suicide prevention. Youth leaders and community coordinators shared that their work helped to build a safety net in their community. For example, informal sources of support, such as trusted adults who have frequent contact with the youth, were identified and received training on suicide prevention. Program participation also facilitated partnerships between organizations with similar missions, strengthening the community safety net.¹⁷

Coordinators and youth leaders reported witnessing an increased awareness of suicide and suicide prevention in their communities as a result of community awareness events. Community awareness events varied by group and included sign-waving activities, outreach activities, family-friendly events, and t-shirt campaigns. Increased awareness was evidenced by schools and the general community recognizing the youth leader groups

and their overall mission. According to participants, people in the community grew receptive to the topic of suicide and were willing to help the youth-led groups. This also helped to address the stigma often associated with suicide and provided a safe opportunity for community members to share personal stories of mental health challenges.

Sustainability

Theme 5: Sustaining the Momentum. Although youth leaders and community coordinators described the overall process and outcomes of HCCI as positive, they expressed the challenge to sustain the momentum. All coordinators agreed that the 1-year funding support they received was too short for the youth leader groups to meet their goals and/or sustain their efforts of suicide prevention. The community coordinators spoke about the importance of having organizational support to facilitate the success of the program, while community coordinators and youth leaders collectively discussed the importance of engaging more leaders and adults to increase buy-in from the community. Youth leaders enthusiastically expressed their interest to continue the program and see it grow to reach the wider community. This sentiment was expressed by most coordinators who felt HCCI motivated youth to continue their efforts irrespective of organizational support.

Discussion

This study identified multi-level impacts, including benefits and challenges of HCCI. Findings highlight the importance of involving youth as leaders in suicide prevention efforts rather than solely as recipients. Through HCCI, youth leaders increased skills related to suicide prevention and leadership. HCCI also provided a space for relationship-building between peers and trusted adults who provided guidance and support. For youth, having positive adult figures is a major protective factor during development.²³ Providing youth with structured opportunities, connections to people, and environments also aid in the positive development.²⁴⁻²⁵ These findings align with other strength-based approaches that have been incorporated in suicide prevention efforts, such as the Sources of Strength program, a suicide prevention program that aims to build socio-ecological protective factors and decrease suicide risk factors.²⁶

Youth leaders and community coordinators reported being identified as gatekeepers by their peers, family members, and the general community due to their ability to provide access to resources. The development of protocols and participation in suicide prevention trainings helped to establish processes for supporting people in crisis. The youth-led activities helped to initiate conversations about suicide in the community while reducing stigma that is often associated with this topic, which reflect the findings from similar studies.²⁷⁻²⁸ Community organizations with similar missions were also able to collaborate, increasing the visibility of community strengths and helping

to facilitate a safety net in community. Recognition of community strengths and resources is important, especially when integrating best practices of suicide prevention, such as safe messaging, into the community.

Despite the benefits of the program and participants responding favorably to HCCI, sustainability was challenging. Lengthening the time period for funding mechanisms would have been beneficial to ensure sufficient support was in place for staff to dedicate their time and efforts. It is recommended that future program planners provide ample time for relationship-building, provide ongoing and responsive team-building opportunities throughout the program, and pay close attention to the needs and dynamics of the group.¹⁶ Although efforts were made to find alternative funding to ensure long-term suicide prevention efforts in the community, few resources were secured. Rather than community specific programming, a state-wide initiative was established to maintain the safety net created during the HCCI program. Long-term (multi-year) funding continues to be sought in order to provide support to individuals and organizations who would like to continue raising awareness in the community and thus address the stigma around sensitive topics related to mental health concerns.

The findings of this study may be limited by the role of HCCI staff in the data collection, which could have led to social desirability bias. Participants may have felt pressured to provide only positive feedback. Nonetheless, suggestions for sustainability and success of future programs were readily provided, and areas of improvement were identified. This openness may have been due to the existing relationships and the trust that HCCI staff had with community partners. Furthermore, findings may reflect the perceptions of a limited sample of youth leaders. Obtaining multiple perspectives from the other youth leaders who participated in the HCCI program as well as other stakeholders in the community, such as peers, family members, school staff, and community members would help to validate these findings.

Conflict of Interest

The authors declare that they have no conflict of interest.

Disclosure Statement

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Two Cases of Infant Botulism Presenting with Altered Mental Status

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Abstract

Infant botulism is a progressive process described as starting with descending weakness, facial palsies and constipation. Loss of bulbar reflexes and flaccid paralysis are common in infants less than 6 months old who have infant botulism. Clostridium botulinum, the bacteria that produce the toxin that causes this condition, are ubiquitous in the United States including Hawai'i, but infant botulism is rarely reported here. This report describes 2 cases of infant botulism with atypical initial presentations diagnosed on O'ahu, Hawai'i. Patient A is a 3-month-old male who presented with altered mental status, including inconsolability, who progressed to loss of gag reflex and constipation. Due to early concern for meningitis, Patient A was treated with antibiotics, however further evaluation led to eventual positive testing for botulinum B toxin. Patient B is a 2-month-old female who presented with somnolence and fever after immunizations and progressed to respiratory failure and apparent dehydration. Because she presented shortly after receiving immunizations, metabolic disorders were strongly considered as a potential cause of symptoms, but Patient B had normal metabolic evaluation and eventually tested positive for botulinum A toxin. Altered mental status and fever are unusual presentations for infant botulism. Infant botulism should be considered in infants with altered mental status when the course of illness includes the development of constipation and weakness, and evaluations are not suggestive of alternative causes, including infection, metabolic diseases, and spinal muscular atrophy. Early consideration and treatment of infant botulism should be considered for infants presenting with altered mental status who develop neuromuscular weakness. The Infant Botulism Treatment and Prevention Program (www.infantbotulism.org) should be contacted early for assistance with diagnosis and treatment.

Keywords

Infant botulism

Abbreviations

CDC = Centers for Disease Control and Prevention

CSF = cerebrospinal fluid

ED = emergency department

IBTTP = Infant Botulism Treatment and Prevention Program

SMA = spinal muscular atrophy

Introduction/Background

Infant botulism, first described in 1977 as acute infantile motor unit disorder, is caused by a toxin produced by *Clostridium botulinum*.¹ The progression of infant botulism includes a 3-30 day incubation period followed by symmetric descending motor weakness, constipation, and cranial nerve palsies. Infant botulism has been described with a large variety of clinical presentations, most commonly hypotonia, flaccid paralysis, and loss of bulbar reflexes in infants less than 6 months of age.² It is an acute progressive condition that is not usually

associated with preceding febrile episodes nor altered mental status.² Infant botulism, unlike other forms, is caused by gut colonization with *C. botulinum* and can be transmitted by dust particles. Patients may not have a history of exposure to home canned foods or honey ingestion, which lead to food-borne botulism.³ Early diagnosis and treatment can markedly improve the natural history and recovery from infantile botulism.⁴ The challenge of treatment within Hawai'i is the delay in receiving the medication from the mainland.⁵ This report includes 2 cases of infant botulism with novel presentations and chief complaints of altered mental status and, in 1 case, fever.

The families of both patients presented provided consent for the use of their child's de-identified case information for both the purposes of education and publication. As no experimental treatments or protocols were used in either case, formal Tripler Army Medical Center Institutional Review Board approval was waived.

Case A Presentation

Patient A was a 3-month-old male who presented to the emergency department (ED) with inconsolability for 16 hours. His parents reported that the patient started vigorously crying the night prior and had not stopped for longer than 10 minutes since that time. The parents also reported decreased oral intake and low urine output. Patient A had been healthy except for congestion, which had improved from the preceding week. Initial concern was for meningitis due to inconsolability, and cerebrospinal fluid (CSF) and blood were obtained. Broad spectrum antibiotics were started. Initial studies revealed no abnormalities consistent with infection in blood or CSF culture, complete blood count, complete metabolic panel, or CSF glucose levels, protein levels, or gram stain. The patient was admitted and cultures remained negative. With negative infectious work up and persistent marked irritability, metabolic disease screening was initiated, but serum lactate, ketones, ammonia, and pyruvate were normal for age. On day 2 of the hospitalization, the patient became increasingly hypotonic with decreased gag reflex. Subsequently, he was transferred to the Pediatric Intensive Care Unit and intubated for airway protection. Over the next 2 days he developed constipation and had decreasing peripheral reflexes. Given the evolving symptoms, infant botulism was considered and the team contacted the California Department of Public Health's Infant Botulism Treatment and Prevention Program (IBTTP; www.infantbotulism.org) who provided botulism immune globulin (intravenous human) (brand name BabyBIG).⁶

Confirmatory stool testing was completed and found positive for botulinum toxin B. The patient started to have spontaneous movements within 4 days of administration and was extubated after a total of 19 days. Patient A was discharged with minimal clinical deficits after a 5-week hospital course.

Case B Presentation

Patient B, a previously developmentally normal and healthy 2-month-old female, presented to the ED with fever up to 102°F as well as decreased feeding and activity that had started within hours of routine immunizations. On exam, she was markedly somnolent with hypertension and decreased response to painful stimuli. Initial concerns were for sepsis, dehydration, and encephalopathy. Infusion of crystalloid fluid boluses to correct poor perfusion due to early sepsis or dehydration did not improve her mental status. CSF, blood and viral cultures, C-reactive protein, and a complete blood count were obtained, and all were normal. A cerebral fetal monitor was placed to assess for any seizure activity, and brain magnetic resonance imaging obtained. Both tests had normal results. Ophthalmologic exam was normal. The patient developed respiratory failure due to hypoventilation 3 days after admission and was intubated. Metabolic testing revealed normal lactate, liver enzymes, and ammonia levels. The patient developed progressive peripheral hypotonia and loss of gag reflex on day 4 of hospitalization and was given a dose of botulism immune globulin on day 6 of her hospitalization after consultation with IBTPP.⁶ Stool testing confirmed the presence of botulinum A toxin. She had return of a gag reflex three days after botulism immune globulin administration, with full gag reflex on the day of extubation. She remained in the hospital for a 4-week course with a total of 10 ventilator days. She was discharged with continued oromotor dysfunction requiring nasogastric tube feeding, but her neurological exam was otherwise normal.

Discussion

The symptoms of infant botulism have been well described as descending paralysis, optic palsy, decrease in symmetric facial movements, poor feeding, and weak cry followed by constipation and hypotonia.² Both of these cases involved presentations that were atypical, with altered mental status (inconsolability and somnolence) as the presenting symptom. Although altered mental status can be present in wound and food-borne botulism, it is not common in the infant form.⁷ Both patients initially presented with central neurological symptoms, and in 1 case, fever prompted initial evaluation and treatment for infection and metabolic disorders. Neither infant had been fed with anything other than infant formula or breastmilk, and neither had known outdoor exposures at time of admission. With neither infant showing the classically described symptoms of infant botulism, the diagnosis was not considered for several days even after the onset of symptoms. Patient A eventually developed a weak cry and Patient B had decreased feeding and somnolence, but neither

exhibited optic palsy, descending paralysis, or constipation in the first few days after presentation.

Infant botulism treatment includes supportive care, but the course of illness can be reduced with early treatment with botulism immune globulin. With broad initial differential diagnoses in both children with initial concerns for more common metabolic disorders or infectious disorders, the initial collection of stool samples and testing was delayed, but still within the treatment window of 7 days from the onset of symptoms with a mean of 4 days until administration.^{4,5} Treatment with botulism immune globulin (intravenous) decreases hospital length of stay from 35 days to 15 days on average.⁸ In addition, infants treated earlier in the course (within 3 days) have further reductions length of stay and long-term sequelae compared to infants treated within 4-7 days of symptom onset.⁵ The delay in administration in these cases was due to the unusual presentations.

Patient B had the additional confounder of timing with immunizations. Fever is not associated with infant botulism, and high fever of 102°F in an infant is more concerning for a serious bacterial infection or an underlying metabolic derangement. Fevers, especially high fevers, are rare with botulism and usually are due to secondary bacterial infections or wound botulism.⁷ Patient B's presentation was confounded by the timing with immunizations, which as a stressful event can precipitate metabolic derangements. Infants with underlying metabolic disorders can have metabolic crises precipitated by immunizations and often present within days of the immunizations with fevers and encephalopathy.^{9,10} Because of patient B's fevers and neurologic symptoms, metabolic disorders were considered, but with a good response to botulism immune globulin further metabolic testing, beyond that described above, was not performed.¹¹ With further progression of Patient B's course, along with no improvement after several days post immunizations and an otherwise unremarkable laboratory evaluation, administering botulism immune globulin was determined to be more beneficial than continuing supportive treatment only. The apparent dehydration seen upon admission was consistent with autonomic derangements that can be present in infants with infant botulism, such as decreased salivation.⁷ Patient B received treatment within the window and recovered.

Other conditions that can cause symptoms similar to those of infant botulism should always be considered in potential cases; in one study, spinal muscular atrophy (SMA) was identified in 19% and metabolic disorders in 16% of cases with other identified causes of negative laboratory confirmed infant botulism like illnesses.¹¹ For both infants presented here, conditions other than botulism became less likely after several days of metabolic laboratory evaluation showed normal values. Patients with SMA type 1 can present in the timeframe that the infants presented in our series, however the altered mental status of the infants does not fit with SMA.

Botulism is a reportable disease to the Centers for Disease Control and Prevention (CDC) which maintains a database of the cases that are reported from throughout the United States.¹² Although botulism can be associated with canned goods and honey in infants, there is a higher likelihood of environmental exposure if the patient's history does not support those sources. *Clostridium botulinum* is ubiquitous in the soil world-wide (except for Africa) and can be a source of disease in infants.⁶ Cases of infant botulism have been reported in all 50 states; the states with the highest annual incidence of reported cases include California, Maryland, New Jersey, Pennsylvania, and Texas.¹² In Alaska, food-borne botulism associated with home canned foods is more common than other parts of the country.¹² In Hawai'i, where both cases presented, no cases were reported to the CDC from 2008-2016, and 3 cases including these 2 were reported in the last 3 years.¹² The recent increase in cases in Hawai'i shows there is a need for awareness, better identification, and timely treatment. When evaluating infants with altered mental status, botulism should be strongly considered if other diagnoses do not fit the initial evaluation or symptomatology progresses.

Conclusion

A high index of suspicion for *Clostridium botulinum* is necessary in patients with altered mental status without a readily identifiable cause, particularly for patients who present in areas of low botulism prevalence, such as Hawai'i. Providers who are considering a diagnosis of infant botulism should make early contact with the IBTPP to help facilitate diagnosis and treatment.⁶ Careful attention to symptom progression including constipation and loss of reflexes is important in making this diagnosis in atypical cases such as those presented. Timely use of botulism immune globulin is associated with improved outcomes including decreased length of stay and time in the intensive care unit. Both patients presented here showed improvement in their reflexes and respiratory effort after the use of botulism immune globulin prior to definitive botulism diagnosis. In infants with unusual presentations, such as altered mental status and fever without other identified causes, providers should consider infant botulism.

CPT August and LTC Hamele are officers in the United States Army. The views in this article are their own and do not reflect the views of the United States Army, Department of Defense, or the United States Government.

Conflict of Interest

None of the authors identify a conflict of interest.

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Mapping the Trends of Kawasaki Disease in Hawai'i from 1996 to 2018

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Abstract

Kawasaki disease is a systemic vasculitis of unknown etiology and is the leading cause of acquired heart disease in children in the developed world. Historically, Hawai'i has had the highest incidence of Kawasaki disease in the United States, likely due to the population's unique ancestral composition. To analyze the epidemiology, demographics and spatiotemporal distribution of Kawasaki disease in Hawai'i, a retrospective chart review was conducted utilizing data from Kapi'olani Medical Center for Women and Children encompassing the period of 1996-2018. A total of 858 patients were analyzed with 877 episodes of Kawasaki disease. On average, 37 episodes of Kawasaki disease were diagnosed annually over the 23-year period. The annual incidence was 32 per 100 000 children <5 years of age. Asian children (66.1%) accounted for the majority of cases, followed by Native Hawaiians and Other Pacific Islanders (16.6%). Unlike Japan and the continental United States, there was no characteristic seasonal pattern in the distribution of Kawasaki disease in Hawai'i, which may be attributed to its tropical climate or the recent changes in global weather patterns. Local geographical differences in the incidence of Kawasaki disease demonstrated that the Windward (Eastern) coast of O'ahu had a higher rate, while the Leeward (Western) coast displayed a lower incidence rate. This could be explained by variations in ethnic composition and weather patterns of certain areas. Future studies could provide geographical weather data and statistical analysis to determine what environmental triggers are correlated with Kawasaki disease trends in the State of Hawai'i.

Keywords

Kawasaki disease, coronary artery dilation, aneurysm, epidemiology, incidence

Abbreviations

CAD = coronary artery dilation

IQR = interquartile range

IVIG = intravenous immunoglobulin

KMCWC = Kapi'olani Medical Center for Women & Children

LAD = left anterior descending coronary artery

RCA = right main coronary artery

Introduction

Kawasaki disease is the most common acquired heart disease of childhood; it primarily affects children below the age of 5 and is characterized by features of systemic vasculitis.¹ The first cases of Kawasaki disease within the United States were recognized in Hawai'i in 1976.² The incidence of Kawasaki disease has historically been much higher in Hawai'i than in the continental United States (estimated incidence in United States is 25 per 100 000 children <5 years of age).^{1,3} Higher incidence has been observed in Hawai'i among children of Asian and

Pacific Islander ancestry (62.9 per 100 000), with the highest incidence in Japanese children (210.5 per 100 000), similar to that observed in Japan (309 per 100 000 children <4 years of age).³⁻⁶ However, unlike Japan and the continental United States, where Kawasaki disease has demonstrated seasonal fluctuations with peaks in the winter and spring, no seasonal variation has been observed in Hawai'i to date.^{1,3,7,8} Several proposed models have suggested roles for ethnicity, weather patterns, and environmental exposure to 1 or more infectious agents in the global distribution of Kawasaki disease.⁸⁻¹¹ The Hawai'i medical community has played a unique role in the recognition of the illness and in pioneering contributions to the current standard therapy, and still plays an important role in the understanding of ethnic and environmental influences in the development of Kawasaki disease.

This retrospective study provides a comprehensive analysis of the largest cohort to date of children with Kawasaki disease in Hawai'i and one of the largest multi-ethnic cohorts in the country. Patterns in temporal and geographical distribution were investigated to characterize trends in Kawasaki disease since its documentation in Hawai'i and provide insight into future directions for analysis.

Methods

Study Design and Cohort

A retrospective chart review was conducted at the Kapi'olani Medical Center for Women & Children (KMCWC) that included charts from the 23-year period from January 1, 1996 to December 31, 2018. Data were analyzed from every patient admitted with the diagnosis of Kawasaki disease confirmed by an infectious disease specialist. The diagnosis of Kawasaki disease followed the established international diagnostic guidelines for complete and incomplete Kawasaki disease.¹ Complete Kawasaki disease was defined as the presence of fever ($T > 38.6$ C) for at least 5 days with 4 out of 5 symptoms: rash, cervical lymphadenopathy, conjunctivitis, oral erythema (lips or tongue), erythema of the palms and soles. Incomplete Kawasaki disease was defined as fever with the presence of only 2 or 3 of the above symptoms. In case of incomplete presentation, laboratory studies (such as elevated erythrocyte sedimentation rate) and/or imaging studies (such as coronary artery dilation (CAD) on echocardiogram) were used to confirm the diagnosis of Kawasaki disease. Patients with suspected cases of Kawasaki disease at admission were

excluded from the final analysis if the diagnosis of Kawasaki disease was ruled out prior to discharge. Separate episodes of Kawasaki disease were registered for the same patient (ie, recurrent Kawasaki disease) when the admissions occurred at least 6 months apart. This study was evaluated by the Scientific Review Committee of Hawai'i Pacific Health and was found to be exempt from requiring informed consent.

Data Collection

Patient demographics (age, and self-reported gender, ancestry, and zip code), clinical characteristics (height, weight, date of admission, date of fever onset), laboratory findings (white blood cell count, C-reactive protein level, erythrocyte sedimentation rate, albumin level), IVIG resistance, complete vs. incomplete presentation of Kawasaki disease and echocardiogram values (date of echocardiogram, internal dimensions of the left anterior descending coronary artery (LAD) and right main coronary artery (RCA)) were collected from every study subject at the time of diagnosis. IVIG resistance was defined as the persistence or recrudescence of fever ≥ 36 hours after the completion of IVIG treatment. Complete or incomplete presentation of Kawasaki disease was defined following the American Heart Association guidelines.¹ Ancestry was self-reported by the family and only the single most prominent ancestral or ethnic background was included in the results and table. The self-reported ancestry was extracted from the admission notes and not from the automated electronic database, therefore it reflects more accurately the most prominent ancestry of the patients. Z-scores were calculated for coronary artery dimensions (LAD and RCA) using the Boston formula.¹² Coronary artery dilation was determined by a coronary artery (RCA or LAD) internal diameter z-score of ≥ 2.0 or, for patients admitted prior to 2006, by the explicit statement of the presence of CAD in the echocardiogram report.

Seasonal and Geographical Analysis

Episodes of Kawasaki disease were analyzed by temporal distribution. Fever onset was used to indicate the onset of illness for patients admitted from 2007 to 2018. Due to the inconsistency in which the date of fever onset was reported in medical records during the first decade of the study period, the date of admission was instead utilized to indicate the onset of illness for patients admitted from 1996 to 2006. Temporal distribution of Kawasaki disease episodes was assessed by seasons with annual cut-offs determined by the dates of the solstice and equinox: spring (late March to mid-June), summer (late June to mid-September), autumn (late September to mid-December) and winter (late December to mid-March), by calendar years, "decades" (1996-2006 and 2007-2018) and for the overall study period. Geographical analysis was performed using self-reported zip codes at the time of admission for Kawasaki disease. Subjects were excluded from the seasonal or geographical analyses if the fever onset occurred in a foreign country or within the continental United States.

Statistical Analysis

Categorical variables were expressed as frequency and percentage, and continuous variables were expressed as median, interquartile range, and range. Annual occurrence of Kawasaki disease (admissions) was depicted with a linear graph. Seasonal variation of Kawasaki disease occurrence was analyzed and depicted as a box plot with median and interquartile ranges. Geographical distribution was expressed as the sum of all cases originating from the self-reported zip codes. Excel version 16 (Microsoft Corp: Redmond, WA) was used for statistical calculations.

Results

Cohort Characteristics

This study collected data from every patient admitted with Kawasaki disease to the single tertiary pediatric hospital in the State of Hawai'i between 1996 and 2018. There were 927 patient charts reviewed, and the final cohort consisted of 858 patients with a total of 877 episodes or occurrences of Kawasaki disease, accounting for 19 (2.2%) recurrent episodes (Table 1). There were 479 (55%) males and 398 (45%) females among the 877 admissions, resulting in a male to female ratio of 1.2:1. Most episodes occurred in subjects less than 5 years of age ($n=728$, 83%) and 217 (25%) episodes occurred in infants less than 1 year of age. The most common self-reported ancestry was Asian ($n=580$, 66%), with Japanese ($n=253$, 29%) and Filipino ($n=162$, 19%) ancestries being the most prevalent. Native Hawaiian or Other Pacific Islander ancestry was self-reported in 146 (17%) episodes. Seventy-two percent of patients reported more than one ancestry or ethnicity (ie, multi-ethnic), in which cases only the most prominent ancestral or ethnic background was included in the analysis. Incomplete presentation of Kawasaki disease was registered in 243 (28%) episodes. IVIG resistance occurred in 125 (14.3%) episodes.

Coronary Artery Dilation

Of the final cohort ($n=877$), 187 (21%) episodes had a presence of CAD during the initial evaluation, at the time of admission or diagnosis of Kawasaki disease (Table 1). Episodes from 2006-2018 ($n=477$) were further stratified by z-scores. Of these 477 episodes, abnormal coronary arteries with a z-score exceeding 2.0 were present in 126 (26%) episodes. CAD (z-score ≥ 2.0 and < 2.5) occurred in 34 episodes (7%), and small (z-score ≥ 2.5 and < 5.0), medium-sized (z-score ≥ 5.0 and < 10.0) and giant aneurysms (z-score ≥ 10.0) occurred in 77 (16%), 13 (3%), and 2 (0.4%) of the episodes at the time of diagnosis, respectively.

Laboratory Markers

Inflammatory markers were elevated at the time of Kawasaki disease diagnosis with the median C-reactive protein level of

Table 1. Study Cohort Characteristics (1996-2018)		
		N or median (% or IQR)
Episodes		877
Recurrent episodes		19 (2.2%)
Time between recurrent episodes (years)		2.5 (1.4-4.1)
Female		398 (45.4%)
Age (years)		2.1 (1.0-4.1)
Age distribution	< 6 months	79 (9.0%)
	≥ 6 months & < 12 months	138 (15.7%)
	≥12 months & < 5 years	511 (58.3%)
	≥ 5 years	139 (15.8%)
	Unknown ^a	10 (1.1%)
Ethnicity	Asian	
	Japanese	253 (28.8%)
	Filipino	162 (18.5%)
	Chinese	65 (7.4%)
	Korean	23 (2.6%)
	Vietnamese	15 (1.7%)
	Other Asian	62 (7.1%)
	Native Hawaiian or Pacific Islander	146 (16.6%)
	White or Caucasian	84 (9.6%)
	Black or African American	8 (0.9%)
	Hispanic or Latino	11 (1.3%)
	Unknown	48 (5.5%)
Multiethnic ^b	633 (72.2%)	
Time of fever onset to date of admission (days)		4 (3-6)
Kawasaki disease diagnosis	Complete	555 (63.3%)
	Incomplete	243 (27.7%)
	Unknown	79 (9.0%)
Coronary artery dilation (entire cohort, Z-score ≥2.0) ^c		187 (21.3%)
Coronary artery Z-scores (patients from 2006-2018 only, N=477) ^{****}	Total ≥2.0	126 (26.4%)
	≥2.0 and <2.5	34 (7.1%)
	≥2.5 and <5.0	77 (16.1%)
	≥5.0 and <10.0	13 (2.7%)
	≥10.0	2 (0.4%)
White blood cell count (cells/μL) (normal 4,000-11,000 /uL)		13 8000 (10 700-17 000)
C-reactive protein (mg/L) (normal < 3 mg/L)		29.3 (8.5-88.6)
Erythrocyte sedimentation rate (mm/hour) (normal < 10 mm/hour)		70 (50-91)
Albumin (g/dL) (normal 3.6-5.4 g/dL)		3.8 (3.4-4.1)
Low albumin (<3.6 g/dL)		244 (27.8%)
IVIg Resistance		125 (14.3%)

^a Age was unknown for 10 episodes due to data limitations.

^b The majority of patients (72%) reported more than 1 ancestry/ethnicity, however every patient and every episode was counted only once with the most prominent self-reported ancestry/ethnicity.

^c Before 2004, coronary artery dilation (CAD) was assessed using the Japanese Ministry Criteria, which categorized an internal dimension of < 4 mm as normal, or by subjective assessment. Because this study spans from 1996-2018, the prevalence of CAD (21.3%) may underestimate the actual incidence of CAD. There were 14 additional patients that had no Z-score data or lacked sufficient information to calculate a Z-score.

29.3 mg/L (normal <3 mg/L) and the median erythrocyte sedimentation rate of 70 mm/hour (normal < 10 mm/hour) (Table 1). Low albumin, defined as <3.6 g/dL, occurred in 244 (27.8%) episodes (median 3.8 g/dL, IQR 3.4-4.1 g/dL).

Seasonal Distribution

The occurrence of Kawasaki disease in Hawai'i (number of admissions to KMCWC) varied from year to year over the last 2 decades with the median number of annual episodes of 37 (IQR 32-43) (Figure 1). There was a spike in 2010 with 62 episodes, accounting for a 51% rise from 2009, followed by a 42% decline in 2011. In the remainder of the 23-year period, the number of episodes ranged from 25 to 46 episodes annually. The incidence of Kawasaki disease in children less than 5 years of age was 32.3 in 2017 and 30.8 in 2018.

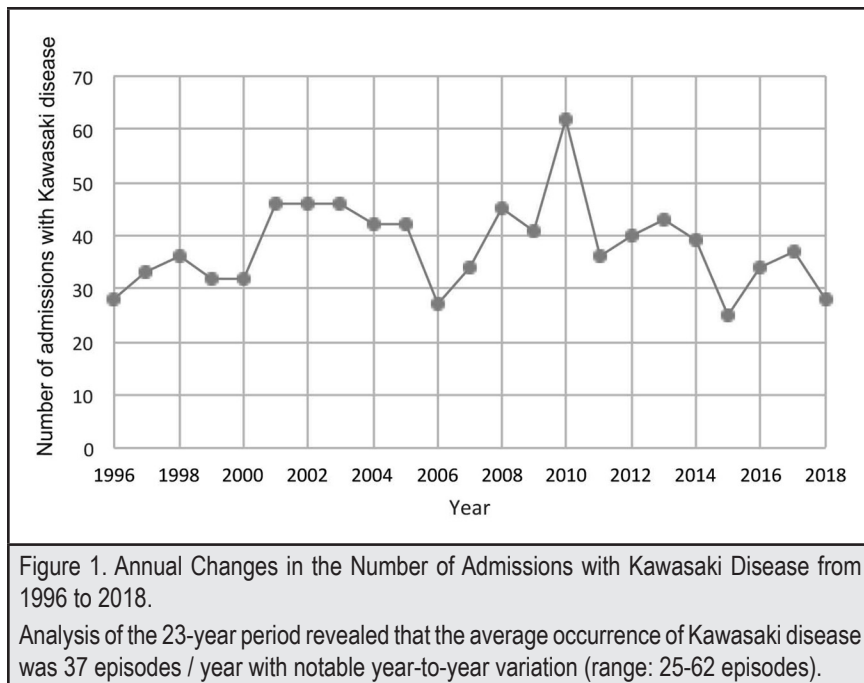
There was no significant seasonal difference (spring vs summer vs. autumn vs. winter) in the occurrence of Kawasaki disease over the entire study period. However, a separate analysis of the number of episodes during the first 11 years of the study period revealed a significantly higher number of episodes in the winter months (n=13, IQR 10-16) compared to the summer months (n=8, IQR 6.5-9.5) (Figure 2). From 2007-2018, peak

activity was observed in the summer (n=10.5, IQR 9-12) and fall months (n=10, IQR 8.5-11.5) compared to the winter months (n=8, IQR 5.5-11.5) without statistical significant difference.

Geographical Characteristics

Of the final cohort of 877 episodes, 851 (97%) had zip codes reported within the State of Hawai'i. Of these 851 episodes, 704 (82.7%) occurred on O'ahu, 74 (8.7%) on the Big Island, 36 (4.2%) on Kaua'i, 33 (3.9%) on Maui and 4 (0.5%) on Moloka'i (Figure 3). For the island of O'ahu, the zip codes with the highest number of episodes were 96789 (n=65), 96744 (n=62), and 96797 (n=62). These zip codes are located in Central O'ahu and the Windward (Eastern) coast of the island. The lowest number of episodes were observed on the North Shore and Leeward (Western) coast.

The total number of episodes in every zip code was adjusted for the total population of the selected area based on the census data from 2018. The highest incidence of Kawasaki disease adjusted for the population of the area was on O'ahu (72.3/100000 inhabitants). Within O'ahu, the highest incidence of Kawasaki disease episodes was observed in the central and Windward regions.



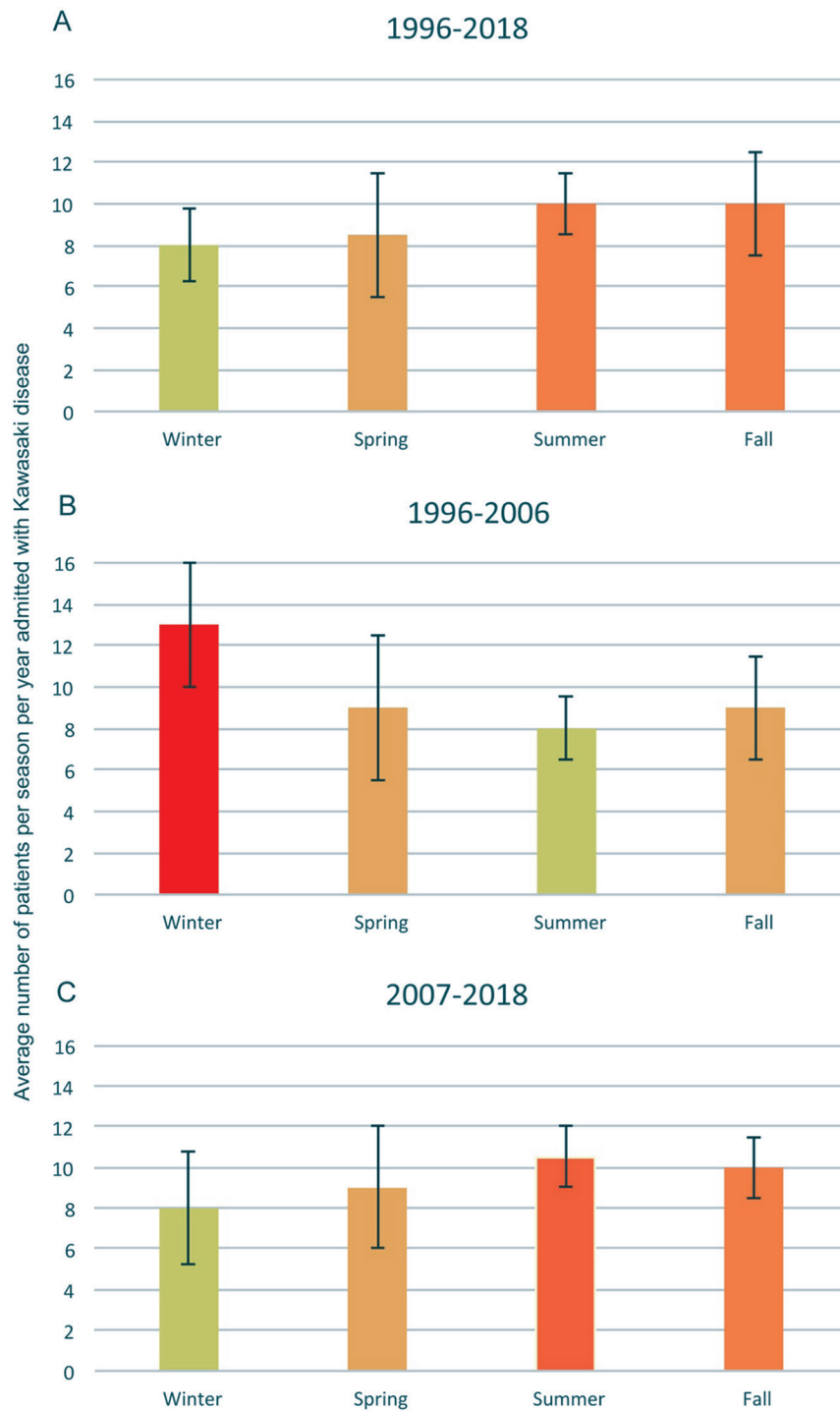
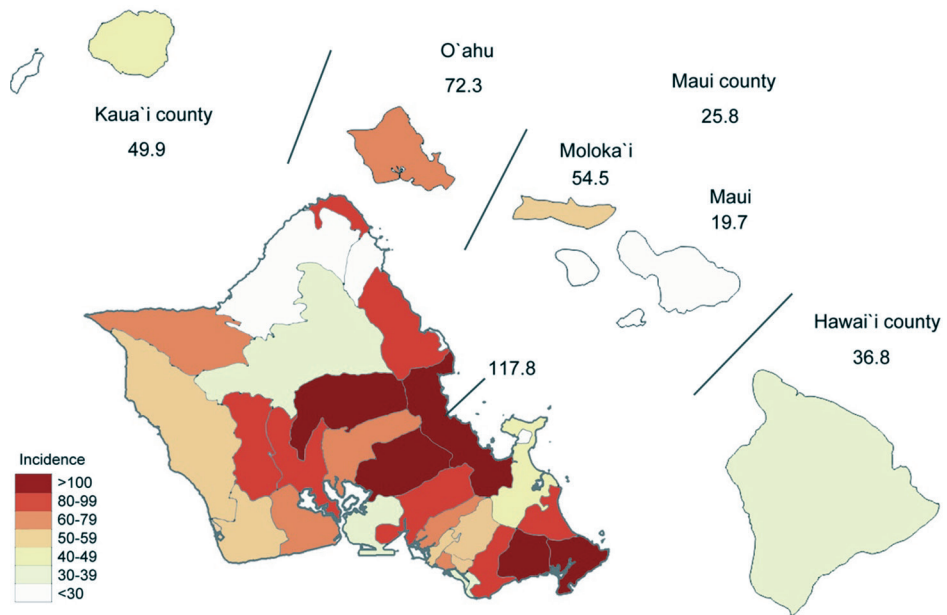


Figure 2. Seasonal Changes in Kawasaki Disease from 1996 to 2018.
 A: The average annual number of episodes in the 4 seasons showed no recognizable pattern in the seasonality of Kawasaki disease for the period of 23 years.
 B: The separate analysis of the 1996-2006 period revealed a characteristic peak of Kawasaki disease episodes in the winter, significantly higher than in the summer.
 C: The analysis of 2007-2018 did not show the same trend: Kawasaki disease occurred slightly more often in the summer and autumn, as compared to the winter (not statistically significant).
 The boxes indicate the median and the bars indicate interquartile range.

Average incidence of Kawasaki disease in Hawai'i between 1996-2018 adjusted for the total population of jurisdicitive areas (zip codes) in 2018



Total number of Kawasaki disease episodes in Hawai'i between 1996-2018

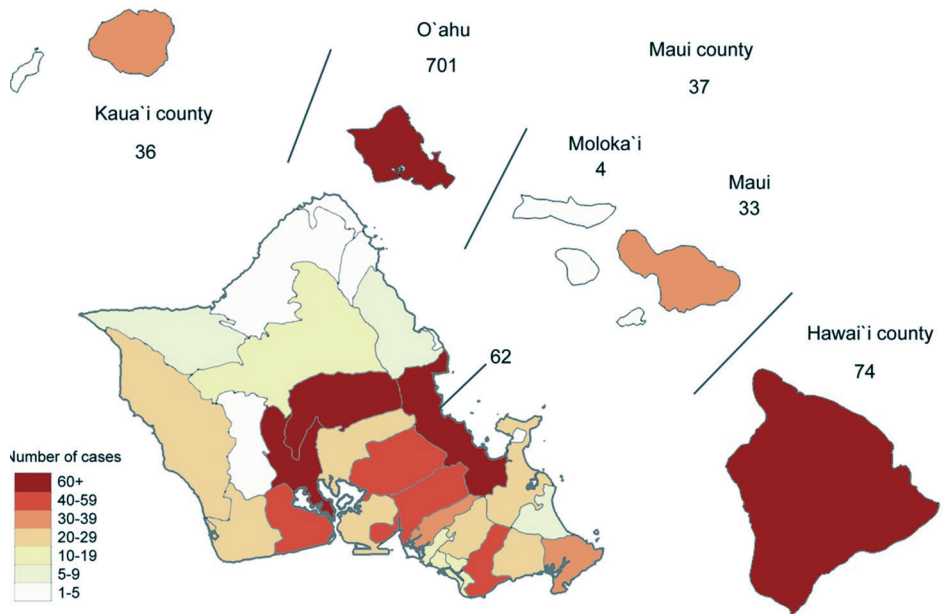


Figure 3. Geographical Distribution of Kawasaki Disease within Hawai'i from 1996 to 2018.

Top: The average annual rate of Kawasaki disease corrected by the population size in 2018 showed that the highest incidence was again in the Windward (Eastern) and Central areas of O'ahu.

Bottom: The highest number of Kawasaki disease episodes occurred on O'ahu, followed by Hawai'i and Kaua'i. Within the island of O'ahu, most cases were registered from the Windward (Eastern) and central regions of the island.

Discussion

A comprehensive evaluation of admissions with Kawasaki disease to the single tertiary pediatric hospital in Hawai‘i in the last 23 years revealed an average annual occurrence of Kawasaki disease of 37 with an estimated annual incidence of 32 in 100 000 children less than 5 years of age.

The incidence of Kawasaki disease continues to be significantly higher in Hawai‘i compared to the continental United States (estimated incidence in the United States is 25 per 100 000 children <5 years of age).^{1,3,13} Our study estimated the incidence at 31-32 in 100 000 children <5 years of age in the last 2 years of analysis. This is very close to what previous studies have found including the analysis of hospital discharge records with Kawasaki syndrome from 25 acute-care hospitals in Hawai‘i.³

The cohort characteristics described in this study are also consistent with previous literature. In this study, 83% of admissions were children <5 years of age and 25% were <1 year of age, similar to the data reported by local and national studies.^{1,11,13} Kawasaki disease has been widely reported to occur in males more frequently than females. This study found a male to female ratio of 1.2:1, comparable to previously reported ratios of about 1.3-1.7:1.^{1,3,6,11} The most prevalent self-reported ancestries were Japanese (29%), Filipino (19%), and Native Hawaiian or Pacific Islander (17%), which is consistent with previous reports.^{1,3,6,11} The ethnic composition of patients with Kawasaki disease is somewhat different that the overall composition of the population of Hawai‘i (38.6% Asian, 24.7% Caucasian, 10% Native Hawaiian or Pacific Islander), likely due to the higher prevalence of Kawasaki disease in patients with East Asian ancestry. The recurrence rate (2.2%) reported in this study falls between the rates previously reported in North America (1%) and Japan (3%).³ The IVIG resistance rate (14%) observed in this study is comparable to rates in previous reports of 10%-20%.^{1,6} The overall rate of CAD was 21% for the entire study period, similar to the American Heart Association’s Scientific Statement in 2017 of 23%.¹ The rate of CAD during 2006-2018 was 26%, which is significantly higher than the 16% during the first decade. This can be explained by differences in the assessment of the coronary arteries: Before 2004, CAD was assessed by the Japanese Ministry of Health Criteria, which categorized an internal dimension of <4 mm as normal, or by subjective assessment. After 2004, coronary arteries were assessed using standards and z-scores.

Seasonal Characteristics

A characteristic winter peak of Kawasaki disease episodes was observed between 1996 and 2006 in Hawai‘i, but this seasonal pattern was not present between 2007 and 2018. Holman and colleagues examined the incidence of Kawasaki disease among children in Hawai‘i from 1996 to 2006 based on data from the Hawai‘i State Department of Health. Consistent with our

findings, they acknowledged the presence of a small peak in the hospital admissions for children <5 years of age seen in December and January. This trend did not continue into 2007-2018 based on our analysis, and the reason could be a shift in the climate.

Burns and colleagues investigated the seasonality of Kawasaki disease through a comprehensive analysis from 25 countries across the globe, including data gathered from Hawai‘i between the years of 1996-2011. Although time series from countries within the Northern Hemisphere contained statistically significant seasonal variations in Kawasaki disease activity with peaks from January to March, the tropics and Southern hemisphere did not show the same seasonal pattern.⁸ In particular, Hawai‘i’s location falls within the tropics and was determined to be “non-seasonal” by the autoregressive/moving average (ARMA) time series model.⁸ Consistently, the overall assessment of the last 23 years of Kawasaki disease onset in Hawai‘i showed no recognizable seasonal pattern.

Kawasaki disease has been hypothesized to be triggered by one or more infectious agents. Multiple studies have suggested the role of tropospheric wind patterns in the transport of potential agents.⁸⁻¹⁰ Exposure to fungal toxins or other environmental factors from Northeastern China may be related to the epidemiological patterns observed in Japan, Hawai‘i, and San Diego.¹⁰ Further studies in Hawai‘i could focus on the occurrence of Kawasaki disease within the last decade in relation to changing local and global weather patterns.

Geographical Characteristics

The majority of residents in the State of Hawai‘i live on O‘ahu, so as expected, most cases of Kawasaki disease were found on O‘ahu. However, even after adjusting for the population of jurisdictional areas (zip codes), the highest rate of Kawasaki disease relative to the total residents of an area was found on O‘ahu. Health care accessibility is greatest on O‘ahu, which could suggest that there are simply more recorded cases in areas with more developed health care systems. Manlihot and colleagues concluded that patients with Kawasaki disease were more likely to live in urban areas, and in environments with low exposure to environmental antigens such as fungi and spores.⁹ O‘ahu is the island with the most industrial development, and the high number of cases could be concurrent with this finding. Using this theory, we would conversely expect to see fewer cases in more rural islands, consistent with our findings of having the fewest cases of Kawasaki disease per residents in Moloka‘i, Kaula‘i and areas of Maui and the Big Island.

Weather patterns could provide further explanations for the geographical variation of Kawasaki disease in Hawai‘i. Large scale wind currents are linked to the illness, suggesting that the trigger could be wind-borne.¹⁰ The windward (Eastern) coast of O‘ahu represents a large portion of the total number of cases, and

its climate is generally windy and rainy with cool temperatures. The Leeward (Western) coast of O‘ahu had significantly fewer cases, and its climate is dry and hot with little vegetation. Future studies could provide detailed geographical data to determine if wind, temperature, or precipitation is related to the occurrence of Kawasaki disease in Hawai‘i.

Study Limitations

This study may underestimate the incidence and registered episodes of Kawasaki disease because patient records were obtained and analyzed only from the single tertiary pediatric hospital in the state and did not include admissions to other hospitals, nor children who could have been diagnosed with Kawasaki disease but were not admitted to any hospital with the illness. Ancestry and residence were self-reported resulting in possible inaccuracy of the collected information.

Data collection and analysis from the first decade were limited for the following reasons: Some of the handwritten medical records kept on microfilm or compact disc were incomplete, and therefore the analysis of laboratory markers and echocardiogram findings were limited in a small percentage of study subjects. Coronary artery dilation before 2006 was assessed subjectively following the Japanese Ministry of Health criteria and therefore may have underestimated the rate of CAD. Due to the lack of consistent reporting in the date of fever onset from the first decade, the date of admission was utilized as an indication for the onset of illness, which may have resulted in a minimally altered seasonal distribution pattern.

Conclusions

Hawai‘i has the highest incidence of Kawasaki disease in the United States, likely due to the unique ancestral composition of its population. There is no characteristic seasonal pattern in the distribution of Kawasaki disease in Hawai‘i, which may be attributed to its tropical climate or the recent changes in global weather patterns. Local geographical differences in the incidence of Kawasaki disease in Hawai‘i could be explained by the particular ethnic composition of certain areas and/or local weather characteristics.

Conflict of Interest

None of the authors have any conflict of interest.

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Patient Safety Initiative Using Peer Observations and Feedback Inspire Collegial Workplace Culture

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Abstract

Following Joint Commission recommendations for standardizing patient handoffs, direct peer observations and feedback were utilized in order to improve patient safety related to transitions of care in the Division of Pediatric Hospital Medicine at Kapi'olani Medical Center for Women & Children.

All hospitalist attendings were trained in an evidence-based handoff bundle inclusive of team communication and feedback strategies. For the initial project, each hospitalist performed 12 peer observations and feedback sessions using validated tools for verbal and written handoffs over 6 months. For a subsequent "refresher" project, each hospitalist performed 6 handoff observations. Attendings were surveyed several times before, during, and after completion of the multiple iterations of the project. A qualitative interview was conducted 6 years after the initial handoff project.

In total, 204 observations were completed by 17 hospitalists during the initial project. The perceived overall quality of the patient handoff improved significantly across shifts ($P < .001$ for the quality of each of two critical daily handoffs) as did pediatric hospitalists' confidence in providing peer feedback ($P < .001$). Downstream effects of this activity led to additional benefits towards the cohesive growth of the division. Themes from post-project qualitative interviews regarding the peer observation and feedback portion of the study included that it was "helpful," "collaborative," and inspired "camaraderie" that led to increased comfort and participation during future opportunities for observation and feedback.

Performing direct peer observations with feedback strengthened the workplace culture, promoted growth through collaboration, and allowed acceptance and success of future projects involving peer observations and feedback.

Keywords

Handoffs, Peer Observations, Workplace Culture

Introduction

Transitions of care, which are increasingly common for the hospitalized pediatric patient, are a common juncture for medical errors, especially those related to lapses of communication between health care providers. Recognizing the safety opportunity, the Joint Commission prioritized implementation of a standardized approach to handoff communications in their 2006 National Patient Safety Goals.¹ A systematic review of hospitalist handoffs published shortly afterwards noted a paucity of literature on this important subject.²

In an effort to improve inpatient handoffs, in 2013 the Division of Pediatric Hospital Medicine at Kapi'olani Medical Center for Women & Children (KMCWC) began the first phase of a quality improvement project to standardize the handoff process that occurred at several points of shift to shift physician transi-

tions of care during the daily 24-7 inpatient staffing schedule. The increasing complexity and diversity of the pediatric patient population and a growing patient census sparked an urgency to move the division towards a structured and consistent team-based approach to transitions of care. This project was designed to maximize outstanding communication within the division by standardizing verbal and written handoffs. An important motivator for the direct observations was the newly assigned Part IV Maintenance of Certification requirement by the American Board of Pediatrics. Additionally, as KMCWC is a teaching institution, there was a strong desire to model good handoff practices for the medical students and residents, who were also learning to utilize the same structured form of handoff communication. The division chose to use the evidence-based I-PASS (Illness Severity, Patient Summary, Action List, Situational Awareness and Contingency Planning, and Synthesis by Receiver) handoff model as an organizing framework for this project.³ Effective implementation of the I-PASS handoff bundle demonstrated a 30% reduction in medical errors and adverse events across 9 children's hospitals.⁴

This project introduced peer mentoring through direct observations and structured peer feedback amongst the hospitalist attendings. Peer observation and feedback have since been described as a means for ongoing workplace coaching and self-improvement in hospital medicine through observing team performance on rounds,^{5,6} teaching activities,⁷ and handoffs.⁸ McDaniel et al published a summary of nationally reported peer observation and feedback activities in hospitalist divisions collected through a national, anonymous survey performed in November 2017 at 12 institutions across the United States.⁹ The project described in our article qualifies as one of the earliest hospitalist peer observation and feedback handoff projects found in the literature.

Methods

This project (HPHRI Study 2012-100) was reviewed and exempted from formal IRB review by the Hawai'i Pacific Health Research Institute as it was acknowledged to be a quality improvement project that sought to improve patient care as part of hospital operations.

Pediatric hospitalist attendings participated in an intensive training session during an off-site division retreat that introduced team communication strategies, the I-PASS handoff bundle,

electronic medical record imbedded tools, and a 1-hour interactive simulation to practice performing peer observations with peer feedback.¹⁰ A handoff tool in the I-PASS structure was created within the electronic medical record to support the verbal handoff; this could be printed or viewed within the electronic health record on the computer. Handoffs occurred between hospitalist attendings during 2 major shift changes: day shift to swing shift at approximately 3-4 pm and swing shift to night shift at approximately 7-8 pm. An additional modified handoff occurred in the morning between the night shift hospitalists to the various day shift hospitalist attendings.

Baseline handoff behaviors were observed by the study investigators and were measured against the ideal I-PASS structure prior to training. Following the training session, each division member performed 12 peer handoff observations of the verbal handoff and provided direct feedback using the I-PASS handoff observation tool. Two sets of peer-to-peer observations and feedback were performed, the first set during the implementation study in 2013 and a second set during a refresher training four years later in 2017. Twelve observations and feedback were performed by each hospitalist attending during implementation and 6 observations and feedback were performed by each hospitalist during the refresher. As an important side note, while further direct observations of handoffs using the observation tool were not conducted, the KMCWC Pediatric Hospitalist Medicine division continues to utilize the I-PASS handoff bundle for shift to shift handoffs.

Hospitalist attendings completed an electronic needs-assessment survey querying group members' opinions of the quality of the current handoff process and individual experience with providing feedback at baseline prior to implementation, then at 8 months, 12 months, and 4 years after initial implementation. The questions were developed based on the I-PASS handoff bundle³ and included demographics, self-assessment of handoff competency, perceptions on quality of the handoffs received, and confidence in providing feedback, amongst other topics. Statistical analysis was performed using SAS statistical software version 9.4 (SAS Institute, Inc., Cary, NC). The Kruskal Wallis test was used to compare the Likert-scale questions among time periods. Fisher's exact test was used for categorical questions.

Qualitative interviews with questions developed with input from the peer observation and feedback literature⁹ were conducted 6 years after initial implementation to elicit focused reflections regarding the experience of performing peer observations and giving peer feedback (see Table 1 for interview questions). The interviews were audio recorded with verbal consent from participants and later transcribed verbatim into a Microsoft Word document. Data was then manually coded using codes that initially arose from the data itself, becoming evident upon multiple reviews by the principal author. Codes were then organized into categories based on grouping of data. Items gleaned from relevant literature were compared against these initial codes, and when appropriate, codes from the literature were assimilated and organized under existing categories. The categories were further assessed and the organized codes more globally considered through a generalized inductive approach until greater themes and subthemes emerged through recognizing overall patterns.

Results

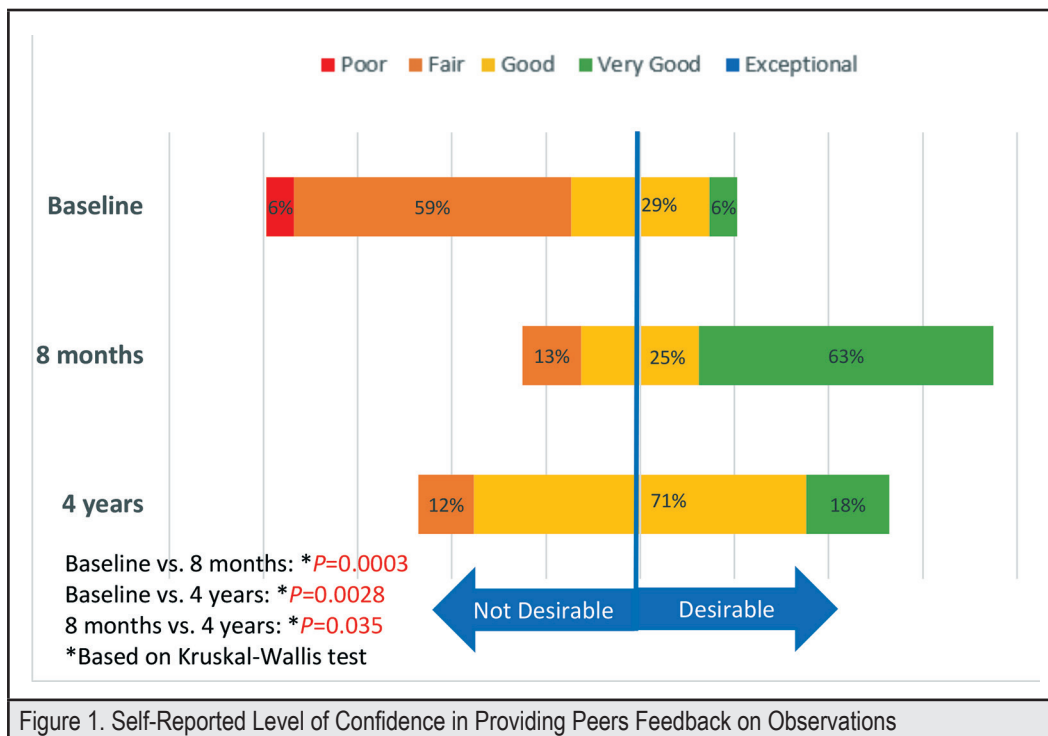
Seventeen hospitalists participated in the initial study and 18 hospitalists (including 6 new members and 12 of the hospitalists who had participated in the initial study) participated in the refresher project. In both phases of the study, the majority of participants were female who had been practicing hospitalist medicine for a mean of between 6-9 years across both projects (Table 2).

Overall perceived quality of other division members' handoffs was rated significantly better at 8 months compared to baseline ($P < .001$ swing shift, $P < .001$ night shift; Table 3). There was also a significant difference between 8 months and 4 years with increased "good" and less "very good" responses ($P = .005$ for swing shift, $P = .036$ for night shift). Self-rated confidence increased significantly from an initial 35% of division members feeling "confident" or "very confident" in giving peer feedback to 88% of division members when asked again 8 months post-project implementation ($P < .0001$). This confidence in giving peer feedback was sustained 4 years post-implementation ($P = .0028$; Figure 1). Hospitalist attendings found more value in peer observations and feedback for skill assessment and self-

Thinking back to the observations and feedback for the KMS Peds Hospitalists I-PASS project, what words come to mind?
Did our hospitalist I-PASS project change your relationship with your colleagues? How?
Do you remember any benefits associated with the process of observations and feedback of the hospitalist I-PASS project?
Do you remember any problems associated with the observations and feedback of the hospitalist I-PASS project?
How did the observations and feedback for the I-PASS project affect your comfort with subsequent division activities which also involved direct peer observations, feedback and open discussion?

	Baseline 2013	Refresher 2017
Number of participants	17	18
Year graduated from residency	1991-2012	1991-2016
Years as a hospitalist (mean)	6.2	8.8
Female : Male	13:4	15:3
Total observations across participants	204	108

Table 3. Overall Perceived Quality of Handoffs Across Shifts						
	Baseline n (%)	8 months n (%)	4 years n (%)	P-value ^a		
				Baseline vs. 8 months	Baseline vs. 4 years	8 months vs. 4 years
Overall perceived quality of handoff from day to swing shift						
Poor	0 (0%)	0 (0%)	0 (0%)	<.0001	.086	.0005
Fair	4 (24%)	1 (6%)	0 (0%)			
Good	13 (76%)	2 (12%)	15 (83%)			
Very Good	0 (0%)	14 (82%)	3 (17%)			
Exceptional	0 (0%)	0 (0%)	0 (0%)			
Overall perceived quality of handoff from swing to night shift						
Poor	3 (18%)	0 (0%)	0 (0%)	.0006	.052	.036
Fair	2 (12%)	1 (6%)	2 (11%)			
Good	12 (71%)	7 (41%)	13 (72%)			
Very Good	0 (0%)	9 (53%)	3 (17%)			
Exceptional	0 (0%)	0 (0%)	0 (0%)			



improvement at 8 months compared with baseline ($P=.045$) and this was sustained 4 years post implementation ($P=.045$). At baseline, 88% of surveyed division members felt peer observations and feedback were important for improving patient safety, which increased to 100% when re-surveyed at 4 years.

Fourteen hospitalists from the initial study (all initial participants excluding the 3 study leaders who are authors of this paper) and 5 additional hospitalists from the refresher study (one hospitalist

was on extended leave and not interviewed) were interviewed using open-ended questions during which several common qualitative themes emerged (Table 4). When asked, “Thinking back to the observations and feedback for the Kapi‘olani Medical Specialists Pediatric Hospitalists I-PASS project, what words come to mind?”, responses included “helpful,” “camaraderie” and “collaborative.” When asked, “Did our hospitalist I-PASS project change your relationship with your colleagues?”, twelve members noted there was no change in their already good rela-

Table 4. Themes in Participant Responses During Four Year Follow-Up Interview of the I-PASS Project (N=19)	
Themes	Coded and Verbatim Responses ^a (parentheses indicate frequency of verbatim responses)
Mixed feelings towards project initiation	Appreciative Scared Nervous Awkward Positive Impatient
Project valued overall	"Helpful" (5) "Valuable" (2) "Useful" (2) Created less stress with future peer observation projects
Workplace culture was positively changed	"Professionalized and normalized giving feedback" (1) Learned from colleagues modelling other styles Systematic approach Consistent behavior Ability to be honest Easier with time and practice
Relationships remained good or were improved	"None" (12) ^b Increased "Camaraderie" (2) Improved with expectations Collaborative Increased Respect
Common barrier of time	"Time" (8) "Interruptions" (2) Difficulty giving constructive peer feedback Competing priorities Project length

^a Overlapping items incorporated from McDaniel⁹ during coding process: identify areas for improvement, feedback less intimidating when received from peers than supervisors, creation of mutually supportive relationships, learning other styles and approaches, opportunity to practice giving feedback, barriers of time management and uncomfortable receipt of peer feedback.

^b All those who noted "none" when asked if this project changed relationships with colleagues indicated the relationships within our division were already good and that this project did not have a negative impact.

tionships. Others indicated that this project helped to improve relationships through consistent communication expectations and helped them to develop a greater respect for their peers' approach to patient care. Almost all (18 of 19) division members interviewed noted that the peer observations and feedback didn't negatively affect their interactions with each other; one hospitalist described the normalized process as "one of the few times I have formally done that with my peers in a way that wouldn't hurt relationships." When asked "Do you remember any benefits associated with the process of observations and feedback of the hospitalist I-PASS project?", nearly all division members reflected on how viewing others' handoff performance and listening to how feedback was given was beneficial towards improving their own practice. There was a learning curve for some when providing feedback to peers, especially when the feedback was constructive, but all commented that performing the feedback improved their comfort and ability in this skill with continued practice. Normalizing the process of observing each other and providing peer feedback helped with future

division activities, such as a project involving observing each other on family-centered rounds and giving feedback.¹¹ When asked "Do you remember any problems associated with the observations and feedback of the hospitalist I-PASS handoff project?", the biggest limiting factor volunteered by 10 of 19 participants was the extra time and coordination that it took to observe handoffs and give or receive peer feedback during a busy clinical day. When asked, "How did the observations and feedback for the I-PASS project affect your comfort with subsequent division activities which also involved direct peer observations, feedback and open discussion?" participants reported it helped them to establish greater comfort and safety with self-allowance of necessary vulnerability when a giver and receiver of peer feedback. Participants noted that practicing strategies of peer feedback was helpful to apply towards future similar projects involving peer observation and feedback during Family Centered Rounds, and that this project laid the groundwork for future collaboration among division members.

Discussion

Working together toward the common goal of improving patient safety through the standardization of pediatric hospitalist handoffs proved successful in improving the reported overall quality of patient care information being transmitted in both verbal and written form. Garnering buy-in from all 17 division members was achieved by surveying division members to glean beliefs and attitudes regarding current handoff processes and tools and by performing observations of baseline handoffs. The structure of the initial training retreat proved to be important in emphasizing the importance of the project and for giving division members the strategies and skills for giving peer feedback and reemphasized the importance of all elements learned from national I-PASS handoff bundle implementation.⁴ Division response to peer observations and feedback confirmed findings recently reported in a novel national survey of pediatric hospitalists on the subject, with benefits of the creation of mutually supportive relationships, learning from others' styles, and improvement through practicing feedback.⁹ All the division members had practice giving feedback to trainees in the past, but most had never given feedback to a peer. Most verbalized they were not used to allowing the vulnerability required to give and receive feedback with other co-workers in the division, which included members with variable experience and in all phases of their hospital medicine careers. The standardized observation tool helped to normalize the process of giving each other feedback, and, with ongoing practice, division members remarked that there was an overall decrease in anxiety, awkward conversations, and indirect wording of constructive suggestions on how to improve practice. Over time, the division accepted this as part of the normal workflow and strove for consistent use of the tool.

Comfort with giving and receiving peer feedback improved with practice as expected, and was sustained for years following this initial project. Division members who were initially skeptical of the peer observations and feedback grew to appreciate their value as a tool for faculty development. Becoming comfortable with and finding value in the process of peer observations and feedback has changed the workplace culture of the division. Shared expectations of colleagues coaching each other to excellence has improved division morale, and although difficult to quantify, this indirectly improved perceptions of patient care. Through structured patient handoffs and the open dialogue of providing peer feedback, this project encouraged sharing of clinical judgment/pearls and clinical reasoning amongst colleagues on both individual and group levels and has therefore allowed the division to grow in new ways.

The process of normalizing peer observation and feedback enhanced the group's camaraderie and proved to be a springboard for the success of additional projects involving peer workplace observations with feedback within the division, following shared division confidence in this culture shift. Subsequent

collaborative projects included observing and coaching each others' teaching behaviors during family-centered rounds and in using structured communication on family-centered rounds. Initiating this observation/feedback process allowed for sustained vulnerability amongst colleagues with an emphasis on the value of group growth and self-reflection. Questions and suggestions for most effective patient care during individual handoffs are now invited amongst division members, whereas previously, these interactions seemed more awkward and perhaps perceived as judgments of individual knowledge and skills due to lack of common practice.

Additional division benefits following this project included the implementation of case-based journal club and formal case review conferences that examine specific patient care circumstances against best practices on a systems level. The authors have surmised that the sustained change in workplace culture has allowed for meaningful frank discussion at these conferences, with division members valuing the opportunities for growth via group reflection instead of fearing a punitive review of suboptimal performance.

Achieving American Board of Pediatrics Part IV Maintenance of Certification (MOC) together as a division was also an important "carrot" which inspired all to strengthen practice to meet this important goal and paved the way for the division to receive MOC through additional group projects.

This study has several limitations. Some of the division members had been preceptors to others during their training, which made some initial feedback sessions especially uncomfortable for the junior members of the division. Observation bias was certainly a factor in performance, but with 204 observations occurring throughout the initial study and 108 observations in the refresher study, the division culture of improving accuracy and standard performance of the handoff was constantly reinforced to the point that it became habit, with only some degradation of precise use of the tool in the years that followed.

The perceived quality of hospitalist handoffs improved from baseline to 8 months and remained improved in a statistically significant manner from baseline to 4 years. However, fewer hospitalists rated the handoff quality at both the swing shift and the night shift to be "very good" vs. "good" at 4 years. One reason for this may be the long time period between the two projects with loss of adherence to the I-PASS structure due to lack of retraining of core content. Another factor includes division staffing turnover (12 of the original members participated in the follow up study 4 years later, but the addition of 6 new division members could have also affected the data). The qualitative interview responses indicated that the lack of continued workplace observations with feedback invited variation into the handoff communication structure as more time lapsed between projects.

The limiting factors of difficulty scheduling observations of handoff and giving timely feedback during busy clinical days were also challenging at times and consistent with a common barrier of time affecting peer observations and feedback as reported by McDaniel.⁹ This was not unbearable, however, and with practice as the project progressed, the division learned ways to minimize disruptions and maximize time management while still providing peers with helpful, timely feedback.

Rallying behind a patient safety goal to improve handoff communication through attending-level peer observations and feedback sustainably improved trust and camaraderie as well as overall workplace culture of a busy pediatric hospital medicine division. Although adherence to the I-PASS structure remained high, the decrease over time underscores the need for ongoing training or refreshing foundational knowledge, workplace observations, and feedback for sustained handoff excellence.

Conflict of Interest Statement

Aside from that mentioned in the disclosures, the authors have no conflicts of interest.

Disclosure Statement

Dr. Patel holds equity/stock options in and has consulted for the I-PASS Patient Safety Institute. The I-PASS Patient Safety Institute is a company that seeks to train institutions in best handoff practices and aid in their implementation. Dr. Patel was not compensated by the I-PASS Patient Safety Institute (which was not in existence for the majority of the timeframe of this project) for any of this work. The other authors have no financial disclosures.

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An Interim Report on the Provision of Prenatal Care for Pregnant Mothers Experiencing Homelessness in Hawai‘i

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Abstract

The State of Hawai‘i ranks third in the nation for homelessness. Homelessness disproportionately affects the health care of pregnant mothers and their children. These homeless persons are at risk for malnutrition, physical and psychological trauma, injuries and chronic illnesses, and have difficulty accessing healthcare and social services. With the generous support of a Waiwai Ola grant from AlohaCare, a non-profit health plan in Hawai‘i, the Maternal-Fetal Medicine physicians at the University Health Partners of Hawai‘i created a pilot program with a midwife and medical assistant to provide prenatal health care and social services for homeless mothers on the island of O‘ahu. This innovative project has given the midwife and medical assistant opportunities to perform needs assessments for homeless mothers and pilot new mobile health devices out in the field that can be optimized for delivering prenatal and postpartum health care for the most vulnerable populations of homeless mothers and their newborns.

Keywords

Homelessness, Pregnancy, Healthcare, Mobile devices, Telehealth, Community outreach, Social services

Abbreviations

*EHR = Electronic health record
HIPAA = Health Insurance Portability and Accountability Act
HOME = Homeless Outreach and Medical Education
HUD = Housing and Urban Development
MFM = Maternal-fetal medicine
MI-Home = Midwifery integrated home visitation program
UHP = University Health Partners of Hawai‘i*

Introduction

The United States (US) Department of Housing and Urban Development (HUD) defines a person as experiencing homelessness if he or she “lacks a fixed, regular, and adequate nighttime residence.”¹ There are currently over half a million people experiencing homelessness in the US, around 35% of whom are unsheltered and living on the streets or in other places unintended for human residences.² The top 4 states, as well as the District of Columbia, with the highest rates of homelessness contain 45% of the entire homeless population of the US despite comprising just 20% of the overall population. More people experience homelessness within tolerable climate zones. The state of Hawai‘i itself has the third highest rate of homelessness per 10,000 inhabitants in the nation (2.7 times the US rate).² In Hawai‘i, the homeless and houseless populations within our communities are seen on the sidewalks, in tent cities at public parks, boat harbors, and underneath overpasses.

A significant issue facing society is how to properly care for persons experiencing homelessness, including providing healthcare when they have an external locus of control. For example, in a qualitative study interviewing homeless individuals, many attributed life circumstances to their current status, with one person saying, “I don’t have any control over who my parents are, where I lived growing up.”³ It is difficult for people experiencing homelessness to prioritize medical care when many of them lack basic needs such as a stable source of food and water as well as a safe place to sleep at night. A lack of affordability of healthcare prevents many homeless people from receiving healthcare as well. While there are avenues of free or reduced care, much of these services still require some sort of copayment, government-approved identification, or a local mailing address that many people experiencing homelessness are unable to provide. The importance of healthcare and other preventive health services is often not well conveyed due to limitations such as mental illness, substance use disorder, and a general lack of awareness.⁴ Many people lack the ability or capacity to fill out the required paperwork and feel that there are inadequate services available to assist them in doing so. The complexity of accessing healthcare services in Hawai‘i is difficult even for those persons with insurance and a high school education. Additionally, people experiencing homelessness believe that there is a lack of compassion within healthcare providers who have unrealistic expectations for self-directed care. Many people experiencing homelessness feel that they are being treated less as a patient that a physician wants to help, and more like a requirement that a physician is burdened to treat.³ These themes bar many homeless persons from seeking the proper medical care for their ailments, resulting in excessive visits to the emergency room and worsening health status as their conditions go partially or incompletely treated.

In 2011, data from the Pregnancy Risk Assessment Monitoring System estimated that 4% of all pregnant women in the US were homeless, with the highest rates in Illinois, Oregon, and Washington.⁴ An estimated 2% of pregnant women in Hawai‘i reported homelessness. In general, women experiencing homelessness were at higher risk for low birth weight, less likely to bring their infant in for well-child visits, and more likely to live in the Western United States.⁴ Children are disproportionately affected by homelessness, with approximately 1.6 million, or 1 in 45, children experiencing homelessness in 2010.⁵ Homeless children are at high risk for nutritional deficiencies, developmental delay, chronic illnesses, trauma, and other behavioral issues. Hawai‘i is known to be one of the most racially diverse states

in the US with no dominant racial majority and approximately 25% of the population being of mixed race.⁶ Moreover, infant mortality rates in Native Hawaiian/Pacific Islanders were 60% higher than in non-Hispanic Whites in 2017, so homelessness only widens those disparities.⁷

Women experiencing homelessness are more likely than women who are housed to report physical violence, substance use, low educational level, obesity or underweight, chronic physical and mental health conditions, and decreased access to traditional health care services.⁵ Many barriers have been identified that hinder pregnant mothers experiencing homelessness from seeking prenatal care and accessing routine prenatal appointments. One qualitative analysis from the Midwestern US demonstrated that pregnant mothers experiencing homelessness faced difficulties with health literacy, lack of transportation, lack of child care, lack of peer support, lack of material necessities, difficulty with stress management, and poor access to telecommunication.⁸ In addition to these barriers to care, pregnant mothers experiencing homelessness in Hawai'i face healthcare challenges that also affect housed pregnant women living with geographical constraints imposed by an island state, with limited access to specialty care on the neighbor islands, and the only neonatal intensive care units located on the island of O'ahu.

The island of O'ahu is divided by 2 large mountain ranges that geographically limit the ability for housed and unhoused pregnant mothers living in rural regions to easily gain access to maternal health care services. These services are primarily based in urban Honolulu, where the only 2 referral hospitals for the State are located. Pregnant women living in rural regions of the island, especially those with substance use disorder, diabetes, history of preterm birth, who do not qualify for health insurance (Medicaid or private), are particularly vulnerable to higher rates of perinatal and infant mortality. The optimization of pregnancy outcome for both mother and fetus in these high-risk pregnancies often require weekly to thrice weekly visits to a healthcare center for fetal assessment in lieu of long-term inpatient hospitalization, which is expensive and separates the pregnant mother from their family.

One healthcare resource available to the homeless population in Hawai'i on the island of O'ahu is the Hawai'i Homeless Outreach and Medical Education (HOME) Project, a University of Hawai'i John A. Burns School of Medicine student-run free clinic staffed by premedical and medical students, residents, faculty, and community attending physicians. The HOME Project, which includes the use of a mobile health van for outreach to more rural areas, provides free medical services at various locations to sheltered and unsheltered homeless persons on the island. Nevertheless, adequate pregnancy care requires numerous visits and resources that would be likely to overwhelm the resources available at the HOME Project.

Methods

The Midwifery Integrated Home Visitation Program (MI-Home) was created as a process and quality improvement project within the University Health Partners of Hawai'i (UHP) with a generous grant from August 2019 to July 2020 from AlohaCare, a local, non-profit health plan. This project was conducted in concordance with the Declaration of Helsinki and was approved by the legal and compliance officers of UHP for protection of these vulnerable clients. This pilot outreach program is one innovative solution to providing care to mothers throughout O'ahu who are having difficulty with accessing prenatal and postpartum healthcare services by integrating modern mobile health technologies with a traditional community health worker model that was recommended by the World Health Organization.⁹ In collaboration with maternal-fetal medicine (MFM) physicians, the MI-Home program is a creative partnership between a certified nurse-midwife and a program medical assistant. They are trained to provide prenatal, postpartum, newborn, lactation, family planning care, and assistance services in a place that is convenient, safe, and private, such as in the client's home, shelter or place of refuge.

Experiential data was collected during the first 6 months of program implementation. Before the first client visit could take place, several unique administrative challenges needed to be addressed in order to launch such a novel community-based program in the state of Hawai'i. Legal and billing compliance concerns were vetted by the UHP leadership, including how to address the issue of prenatal care services being provided in a non-traditional "place of service" and how these services could be coded for billing purposes to comply with current Centers for Medicare and Medicaid Services regulations. For professional liability concerns and for the safety of the outreach providers, the midwife and medical assistant were advised to go out to meet the client as a team. Mobile electronic health record infrastructure needed to be created. Phlebotomy, access to medications, and transportation for clients' health and human services were also addressed. Health Insurance Portability and Accountability Act (HIPAA) compliant texting communication systems are being explored as patients experiencing extreme poverty often depend upon cellular telephones as their lifeline to emergency medical services which they can text from when they have access to free Wi-Fi. Memoranda of understanding with other public health entities were drafted with community partners (Table 1), including the H4's Joint Outreach Center in Kāne'ohe to meet with mothers experiencing homelessness for pregnancy care instead of meeting on a park bench or under a tarp. A variety of mobile health devices (egmHealth) were purchased for evaluation in the field (Table 2). The program launched with a booth at O'ahu's Convoy of Hope in August 2019, a community event and health fair held at the Aloha Stadium to provide information and humanitarian services for homeless and underserved persons.

Results

The first client visit was conducted in a 100 square foot room in a boarding house and lasted three hours. The woman was self-referred; she had suffered multiple physical and psychological traumas and presented with complex mental health disorders and cognitive disability, in addition to her pregnancy. The midwife sat on the floor, intently listening and documenting, as the pregnant mother sat on her sheetless bed and recounted her story. Near the end of the initial visit, she was transported by a shared ride service to a local laboratory to have prenatal bloodwork performed as the midwife drove alongside so that

the client would feel safe. The team recognized that the client's need for case management services was the top priority. This care coordination required applications for general services (Med-Quest, Supplemental Nutrition Assistance Program, Temporary Assistance for Needy Families, Special Supplemental Nutrition Program for Women Infant Children), which take an average of one month to complete per client. Continuity of care during follow up visits addressed the client's health care needs while trust was built between the client and team. Support services were successfully addressed, including bringing a notary public to her residence to complete documents so that she could obtain a copy of her birth certificate in order to obtain a valid identification card. In a matter of two months, the follow-up visits were able to be reduced from two hours to one hour per visit.

Table 1. Referral Partners for the MI-Home Project
Current Partners*
Mary Jane Shelter
Hale Mauiola Navigation Center
RYSE shelter (Residential Youth Services & Empowerment)
Waimānalo Health Center
Kokua Kalihi Valley Health Center
Ko'olauloa Health Center
Kahuku Medical Center
Hale'iwa Health Center
Pu'uhonua O Wai'anae
Hawai'i Job Core Center
Kāne'ohe & Chinatown Joint Outreach Centers
Waikiki Health Center
Adventist Health Castle
American Congress of Obstetrics and Gynecology, Hawai'i Section

*Anticipated future partners include: The Queen's Medical Center, Hawai'i Health & Harm Reduction Center, Aloha United Way, Hawai'i Pacific Health—Kapi'olani Medical Center; Behavioral Health Services

The midwife was able to debrief with the MFM physician after the initial visit to discuss what healthcare services would be needed. The midwife was also able to learn about multiple emergency room visits by the same woman to different hospitals and reconcile the differences in antibiotic prescriptions that were given at each site within a one-week period, to prevent any medication errors. With future appointments, the midwife has the ability to collaborate with MFM physicians while she is in the field through an encrypted tablet with HIPAA-compliant video for telehealth services. This ensures clients with high risk obstetric conditions have appropriate care plans and empowers the team with the ability to adjust it in real-time to prevent missed specialty appointments, and unnecessary hospitalizations. In addition, the HIPAA-compliant texting communication system being explored will give the client 24/7 access to the midwife to prevent unnecessary trips to the emergency room.

Table 2. Equipment with Mobile Capabilities Under Evaluation in the MI-Home Project	
Device	Function
Mobile Smart Phone	To communicate with clients, receive referrals, and make arrangements for clients; encrypted and secured by UHP Compliance Office.
Portable Wi-Fi Hotspot (Jet Pack)	For secure Wi-Fi access in the field to connect other mobile devices.
Welch Allyn Vital Signs Monitor	Utilizes Bluetooth to populate vital signs directly into EPIC EHR (Electronic Health Record).
GE Logic V2 portable laptop ultrasound	Basic prenatal ultrasound to check presentation, fetal heartbeat, amniotic fluid volume, and placenta locations. Includes Trice for wireless transmission of images for other providers to view and share images with clients instead of paper printing.
Sense4Baby	Wireless electronic fetal monitoring that transmits Non-Stress Test tracings for antenatal fetal surveillance to internet "cloud" for remote real time viewing and storage instead of printing.
iPad with HIPAA compliant Zoom	Telehealth video service to consult with physicians.
Laptop with EPIC	For charting in the field using EPIC HER.
Lyft Application on mobile phone	Connected to company approved card tied to grant for transporting clients.
Portable newborn scale (precision 1g [6kg] 2g)	Has Wi-Fi capability to upload infant weight to EPIC.
Glucometer (Accucheck Aviva)	Has Wi-Fi capability.

After three months, 10 clients were enrolled into the MI-Home program, all referred by community partners, and have continued their participation in this program for prenatal care for the duration of this pregnancy. The MI-Home team quickly identified that all their clients were experiencing complex situations requiring integration with care coordination services and mental health providers, in addition to the direct healthcare services provided by the midwife. The medical assistant's role evolved to serving as a care coordinator and program assistant by developing an individualized care plan according to the patient's needs and goals. She is now fulfilling human services needs during these "home" visits which include providing referrals for medical, food stamps, financial assistance, pregnancy-related education, early child care and early intervention services, nutrition, housing, transportation, and other human services needed to improve the quality of life for the individual and their family. The medical assistant is working closely with the midwife and other health care specialists to ensure continuity of care and re-integration back into the healthcare community and the community at large.

Discussion

Providing prenatal healthcare to mothers experiencing homelessness has provided a magnifying lens to survey the state of health care in Hawai'i. The MI-Home project has already identified worrisome barriers to providing prenatal care to mothers in our state including access to outpatient psychiatric services, telecommunications services that meet HIPAA compliance requirements, harassment and misunderstanding from neighbors, difficulty navigating the insurance system, legal considerations in providing health care in a rented room or on a park bench, and the unrealistic expectations of the medical establishment that requires pregnant mothers to navigate their appointments and health care decisions without considering the other social determinants of health.

As the cost of living and health care in Hawai'i rises, so does the crises of persons experiencing homelessness. The health of our communities is a reflection of the health of our children and families. As supported by the medical literature and this pilot project, the health of our pregnant mothers has the strongest impact on the health of our children, whether they are insured, underinsured, uninsurable (under current laws), or experiencing homelessness. The MI-Home project has given us the opportunity to investigate the challenges within the health care system of Hawai'i, pilot new mobile health technologies in the field to optimize prenatal care, and learn how to navigate a disconnected system for the most vulnerable populations of women and children in our state. The authors hope that lessons learned from implementation of this program will inspire the next generation of health care workers to work with legislators, health plans, and healthcare systems to create a sustainable infrastructure that supports a healthier Hawai'i.

Conflict of Interest

None of the authors identify a conflict of interest.

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Pediatric Code Blue: How Prepared Are We? A Self-Efficacy Assessment Project

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Abstract

Pediatric advanced life support (PALS) recertification every two years is inadequate to maintain proficiency. The authors hypothesized that a standardized, recurring curriculum may enhance retention of cardiopulmonary resuscitation (CPR) skills. Monthly in situ mock code training and an annual online self-directed learning module were implemented for pediatric intensive care unit nurses, pediatric residents, and respiratory therapists at a women and children's hospital. The in situ mock codes were linked to PALS training self-efficacy (pre- and post-mock code) and feedback related surveys. CPR knowledge was assessed using an online module with pre- and post-tests. A total of 82 in situ mock code surveys and 137 online modules were completed over a 20-month period. Medical knowledge ($P < .05$ for 7/10 questions) and self-confidence improved ($P < .001$). Several staff reported a negative impact on their patient care assignments in order to participate in the mock code. However, a significant number of participants (65%) concurred with the benefits of monthly mock codes. The curriculum improved CPR efficacy by improving knowledge-based retention as well as self-confidence in their skills.

Keywords

Cardiopulmonary resuscitation, PALS, Pediatric advanced life support, Refresher, Self-efficacy

Abbreviations

AHA = American Heart Association
CPR = Cardiopulmonary resuscitation
KMCWC = Kapi'olani Medical Center for Women and Children
PALS = Pediatric advanced life support
PICU = Pediatric intensive care unit
RN = Registered nurses
RT = Respiratory therapists

Introduction

Cardiopulmonary resuscitation (CPR) is a crucial aspect of pediatric critical care. First responders during pediatric code blue often are pediatric residents, pediatric nurses, respiratory therapists, and other providers who are not pediatric critical care or pediatric emergency trained physicians. The American Heart Association (AHA) recommends Pediatric advanced life support (PALS) recertification every two years. Unfortunately, PALS training skills and knowledge are often not sustained for the full two-year recertification interval.^{1,2} A variety of PALS curricula have been introduced; however, none are endorsed by the AHA or otherwise standardized.³⁻⁶ These curricula are

important for the retention of knowledge and skills required to utilize PALS algorithms. Self-efficacy, confidence, familiarity, communication, and delegation of tasks are also important aspects of pediatric CPR to ensure successful outcomes.^{1,3,7} Hence, it is imperative to address those aspects as well in CPR related training.

The infrequent occurrence of in-hospital cardiac arrests also limits the providers' efficacy to maintain CPR skills.¹ The experience at our institution would support this conclusion. In 2016, there were 54 pediatric and 5 adult code blue events. A total of 26 events occurred in the Neonatal Intensive Care Unit, 15 in the pediatric intensive care unit (PICU), 10 codes in the Emergency Department, 1 in the Post-Anesthesia Care Unit, 2 in the Adult ICU, 2 in the Family Birth Center, 2 in the pediatric ward unit, and 1 in the Operation Room. Members of the pediatric code blue team respond to all events throughout the hospital. The team is comprised of PICU registered nurses (RN), PICU respiratory therapists (RT), a pediatric emergency physician, and pediatric residents. There are approximately 45 PICU RN, 58 respiratory therapists (RT) and 25 pediatric residents. This exposure to actual code events is insufficient for pediatric code blue team members to master and maintain the various PALS algorithms for resuscitation. This is in conjunction with the authors' belief that PALS recertification required every two years is too infrequent. Therefore, the goal was to create an educational curriculum to bolster the confidence and performance of the pediatric code blue team members.

In October 2017, a blended learning recurring PALS curriculum was created with two components. The first component was a monthly *in situ* mock code in the PICU to sharpen the CPR related practical skills and to augment the self-confidence of the participants. The second component was an annual online learning module which would enhance CPR-related medical knowledge through hypothetical scenarios, followed by questions testing acquired knowledge. It has been suggested that even well-trained providers may not be able to apply their skills and knowledge during the code if they lack self-confidence.³ Hence the objective was not only to enhance medical knowledge and CPR skills, but to also increase self-confidence. The hypothesis was that by addressing these three components through a blended learning curriculum, the self-efficacy of pediatric code blue team members would be enhanced.

Methods

This study was performed at Kapi'olani Medical Center for Women and Children (KMCWC). It is the only tertiary care referral hospital in the entire state of Hawai'i providing comprehensive obstetric and pediatric care. KMCWC is also dedicated to research and medical education. The curriculum was composed of two components: monthly *in situ* mock codes and an annual online learning module. The first mock code was conducted in October 2017 and continued monthly whenever possible. A total of 15 mock code surveys were conducted during this 20-months' study period. The annual online module was started in December 2017. Participants consisted of PICU RN, RT, and pediatric residents rotating through the PICU.

The monthly *in situ* mock codes were conducted in the PICU by the attending physician, a pediatric nurse educator, and a clinical system trainer. A PICU pharmacist was present as support staff but did not participate in the mock code or the survey. Each mock code team consisted of 1-3 pediatric residents, 1-2 PICU RN, and 1-2 PICU RT. These were unannounced events and were not part of the routine PICU training program. The 20-minute active case management simulation *in situ* mock code was conducted using a Pediatric HAL® S3005, Wireless and Tetherless, Five-Year-Old Patient Simulator (Gaumard: Miami, FL). The scenarios were based on select PALS course cases including shock and cardiac dysrhythmias. The learning activities included chest compression, bag-mask ventilation, endotracheal intubation, medication preparation and administration, fluid resuscitation, and synchronized cardioversion and/or defibrillation. Following the *in situ* mock code, direct feedback was provided using a PALS- based structured debriefing. An anonymous PALS self-efficacy pre- and post feedback survey was completed by all participants. The self-efficacy survey included the participant's level of familiarity or comfort with (1) being part of the code blue team, (2) drawing medications during the code, (3) performing chest compression, (4) providing bag mask ventilation, (5) performing or assisting with endotracheal intubation, and (6) using the defibrillator device. A scale of 1-5 was used to rate the level of familiarity for each skill, with 5 representing the most familiar and 1 the least. The ratings for both pre- and post-mock code surveys were recorded on the same anonymous form for each participant, allowing for paired comparisons. The feedback component included (1) the participant's opinion on the optimal frequency of the mock code sessions, (2) the extent to which, if any, participation in the mock code affected their patient care duties, and (3) the quality of the debrief.

The second component of the curriculum was an annual online module where PICU RNs navigated through a small didactic session. This consisted of 15 non-narrated slides. They were designed to take 20 minutes to complete in a self-paced, independent learning environment. There were no clinical scenarios included in the teaching part of the module. The questions,

however, tested the trainee's knowledge using clinical scenarios. The specific content of the modules and the questions included CPR principles, management of shock and dysrhythmia, and the science of resuscitation. The scoring was recorded for each individual and a minimum of 80% correct answers was required to pass the post-test. The rationale for selecting an 80% passing score was based on pilot testing of pediatricians, pediatric residents, and senior PICU RN. The questions in the pre-test and the post-test were identical; correct answers were provided at the conclusion of the post-test. Only PICU RNs participated in the online curriculum during the first year. The same curriculum was repeated the next year and all the RNs participated in the curriculum.

The mock code events and the online modules were approved by the Quality Improvement Committee of the institution. All surveys and the test questions were anonymous. Accordingly, Institutional Review Board exemption was obtained prior to the initiation of this project. Results of all participant surveys were analyzed. Since the PICU RNs group participated in both annual online module and monthly *in situ* mock codes, a subgroup analysis of PICU RNs was carried out for the PALS self-efficacy survey. The goal of this subgroup was to determine the impact of the annual online module on the *in situ* mock code survey results. Another subgroup analysis investigated the impact of repeat participation in the *in situ* mock code.

Statistical Analysis: Fisher's exact test for online module survey (categorical variables) and a Wilcoxon signed rank test for PALS training self-efficacy survey (non-parametric) were performed using a GraphPad Prism version 8.0.0 (GraphPad Software: San Diego, CA). A two tailed *P*-value of $< .05$ was considered statistically significant.

Results

Survey results over 20 months from October 2017 through May 2019 were analyzed. There were a total of 82 PALS training self-efficacy and feedback surveys from participants in 15 *in situ* mock codes. Those who completed the surveys included 25 pediatric residents, 42 PICU RNs, 14 RTs, and 1 PICU nurse academy student (Table 1). A total of 14 participants repeated the mock code activity at least once during the study period.

Table 2 shows the results of the PALS training self-efficacy survey. The numbers represent the mean level of familiarity

Participant Designation	Number of Participants
Pediatric Residents	25
PICU RNs	42
PICU RTs	14
PICU Nurse student	1

or comfort of all first-time participants for six skills, using a scale of 1 to 5 (highest), prior to and after the mock code. They represent the results from the entire cohort participating in the in situ mock code. Table 2 also shows the first subgroup analysis for the PICU RN, who participated in the annual online module in addition to the monthly in situ mock codes. The second subgroup analysis includes those who participated in in situ mock codes more than once. This second subgroup included 12 PICU RNs, 1 PICU RT, and 1 pediatric resident.

In relation to the feedback component of the mock code survey, the authors requested the opinion of the participants regarding the optimal frequency of the in situ mock code. Of the 82 valid responses, 17% responded once a week, 65% responded once a month, 14% responded once every 3 months, 2% responded once every 6 months, 1% responded once a year, 1% deferred to respond and no one responded not at all. This study also asked if participation in the mock code affected the patient care assignment for that day. Of the 82 valid responses, 26% responded: “Yes”, 39% responded “No”, and the remaining 35% deferred to respond. The mean reported effectiveness of the debrief for all mock codes was 9 on the scale of 1 to 10.

The number of participants for the online modules was 69 in 2017 and 68 in 2018, totaling 137 participants completing the module and the test (Table 3). Improvement in the post-test score was statistically significant for 7 of 10 questions for the combined 2-year analysis. Ninety-five participants filled out module specific surveys for the feedback to the organizers. Of the 95 valid responses, 37% responded that the module was extremely helpful, 36% responded that it was very helpful, 27% responded that it was helpful, and no one responded that it was not helpful. Of the 95 valid responses, 2% responded that the module was too easy, and 98% responded that it was appropriate for the level of training, and none responded that it was too difficult. No one reported any commercial bias. The discrepancy in the number of participants in the pre- and the post-test resulted from some participants requiring more than one attempt to pass the test.

Table 2. PALS Training Self-efficacy for Level of Familiarity of the Participants on Six Skills on the Scale of 1 to 5

Survey item	Pre-mock code (mean)	Post-mock code (mean)	P value ^a
Being part of the team			
All participants (n=82)	3.03/5	3.63/5	<.001
PICU RN subgroup (n=42)	2.83/5	3.60/5	<.001
Repeat participants subgroup (n=14)	3.14/5	3.79/5	.008
Drawing medication			
All participants (n=82)	2.72/5	3.13/5	<.001
PICU RN subgroup (n=42)	3.20/5	3.73/5	<.001
Repeat participants subgroup (n=14)	3.00/5	3.64/5	.130
Doing chest compression			
All participants (n=82)	3.90/5	4.18/5	<.001
PICU RN subgroup (n=42)	3.71/5	4.12/5	<.001
Repeat participants subgroup (n=14)	3.83/5	4.00/5	.25
Providing bag mask ventilation			
All participants (n=82)	3.88/5	4.07/5	<.001
PICU RN subgroup (n=42)	3.54/5	3.91/5	.004
Repeat participants subgroup (n=14)	3.50/5	3.73/5	.50
Doing/assisting endotracheal intubation			
All participants (n=82)	3.47/5	3.68/5	<.001
PICU RN subgroup (n=42)	3.32/5	3.56/5	.008
Repeat participants subgroup (n=14)	3.45/5	3.70/5	.25
Using defibrillator during code			
All participants (n=82)	2.72/5	3.39/5	<.001
PICU RN subgroup (n=42)	2.83/5	3.43/5	<.001
Repeat participants subgroup (n=14)	2.79/5	3.46/5	<.031

^a Based on the Wilcoxon signed rank test.

Table 3. Correct Answer in Percentage for Online Module Knowledge Analysis, Before and After the Training Module (Pre- and Post-test)

	Years 2017-2018			Years 2018-2019		
	Pre-Test (n=69)	Post-Test (n=78)	P value ^a	Pre-Test (n=68)	Post-Test (n=74)	P value ^a
Question 1	46.38%	97.44%	<.001	44%	93%	<.001
Question 2	59.42%	94.87%	<.001	79%	100%	<.001
Question 3	62.32%	96.15%	<.001	82%	95%	.032
Question 4	23.19%	85.90%	<.001	37 %	86%	<.001
Question 5	31.88%	67.95%	<.001	19%	65%	<.001
Question 6	52.17%	83.33%	<.001	56%	95%	<.001
Question 7	73.91%	87.18%	.057	79%	88%	.254
Question 8	65.22%	80.77%	.040	78 %	85%	.286
Question 9	56.52%	92.31%	<.001	66%	99%	<.001
Question 10	37.68%	97.44%	<.001	51%	99%	<.001

^a Based on the Fisher exact test

Discussion

This study revealed that a 20-month program of a blended PALS learning curriculum enhanced self-efficacy of pediatric code blue team members. Specifically, results of monthly in situ mock codes showed a significant increase in familiarity with CPR associated skills. In addition, the annual online module was associated with improved CPR related medical knowledge in the RN team members. These results support the study hypothesis, and in doing so address the three key components considered essential to resuscitation training; namely medical knowledge, CPR skills, and self-confidence.¹ Furthermore, the program addressed gaps in pediatric resident training,¹⁻³ and the authors anticipate it will enhance long-term CPR-related patient outcomes.

The results are similar to those of several published studies.⁴⁻⁶ One study reported increased comfort and knowledge in pediatric residents after a one-year program of mock codes.⁴ However, this study lacked any complementary on-line educational tools. Further, the authors reported that anonymous surveys limited their ability to utilize paired statistics. In contrast, mock code surveys in the present study were also anonymous, but participants filled out the pre- and post-mock code surveys on the same form, facilitating the use of paired statistics. Another office-based, 2-step curricula showed increased provider confidence and decreased anxiety related to actual code events. The curricula used in this study was similar to the present one, including educational didactic and in situ mock codes.⁵ Another office-based quality improvement program including mock codes showed improved emergency preparedness and CPR related skills. Neither level of familiarity nor anxiety were evaluated in that program, although the concept of unannounced mock code was well received.⁶

Subgroup analysis was performed on two separate components. First, an analysis was performed on PICU RN, since they represented the only team members participating in both online module and in situ mock code. The results of this subgroup were found to be similar to the full cohort of participants. Thus, although the annual on-line module improved CPR knowledge, it had little impact on performance of the PALS self-efficacy post-mock code survey. Clearly, while complementary in nature, different skill sets were tested after the on-line module to those of the mock code. Another subgroup analysis involved the members who participated in more than one in situ mock code. There were notable differences found after repeat participation, which the authors believe were artifactual in nature. This was a result of the higher scores found with certain skills in the repeat participant group, both prior to and after the mock code. It is believed this represents an accumulated “level of familiarity” gained during the previous mock code, rather than any alternative explanation. Finally, pre-test scoring of the online module was higher after repeating it in the second year as compared to

the first year, again suggesting an accrued retention of medical knowledge from first year participation.

There were several limitations of this study including the modest sample size and lack of control group. Another weakness was the in situ mock code surveys were subject to individual and subjective interpretation. A final concern was the inability to conduct the in situ mock codes predictably on a monthly basis, as envisioned. Naturally, since patient care is the ultimate concern of any hospital unit, the ability to conduct monthly mock codes was dependent upon the actual census and patient acuity in the PICU. Mock code participation also competed for staff time dedicated to patient care duties. Indeed, 21 (35%) participants reported a negative impact on their patient care assignments while participating in mock codes. Nevertheless, the majority of the participants (65%) touted the overall benefits of the monthly mock codes. Clearly, it was concluded that conducting in situ mock code was appropriate and of overall benefit for the PICU.

One concern regarding pre- and post-mock code scoring deserves attention. Although the focus of the mock code was a practical hands-on simulation review of the cognitive, manual, and team interactions required during active resuscitation utilizing the PALS algorithms, participants typically gravitated to their respective professional roles according to their specialty. Thus, certain questions in the mock survey may not be as relevant to certain specialties which may lead to misleading conclusions. For example, scores for drawing medication were typically high, while scores for bag mask ventilation and intubation were lower for the RN team members as compared to the full group of participants. Although it would be ideal to have all team members versed in all aspects of resuscitation, this may not be a realistic expectation. Future refinements in the mock code survey should consider factors related to individual staff roles and responsibilities.

It is also important to reveal that certain skills were not graded or analyzed such as bag-mask ventilation and chest compression. However, fundamental knowledge of these skills was tested in the online learning module. The authors also provided direct feedback to the participants on the effectiveness of bag-mask ventilation and chest compression during each mock code; however, these considerations were not included in the results or analysis. This is consistent with the design and analysis of previous studies.⁴⁻⁶ Other parameters, such as participant “years of experience” and history of participation in real and mock codes, were not factored into the analysis. Sequencing of interventions, such as having an instructional session precede the mock code experience, has been proven beneficial in critical care.⁸ There is recent evidence that the “flipped classroom approach” has also been of value in graduate medical education.⁹ In either case, a fully engaged sequential instructional program was beyond the scope of the present study. A blended learning curriculum was utilized, focusing all team members

as active participants in the process of simulated resuscitation, with sharing of experiences, and the application of skills and knowledge.⁹ The on-line learning module was tested on a subset of participants, the RN's, to determine the acceptability and value of including and or expanding this component in future iterations of this quality improvement project.

In conclusion, the PALS curriculum played an important role in cementing knowledge and self-efficacy of pediatric code blue team members at KMCWC. Monthly participation in utilizing in situ mock codes and completion of annual online modules were appreciated and well received. The interest in retaining CPR skills, knowledge, and confidence opens new opportunities for future research aimed at optimizing outcomes of children undergoing CPR. Future hospital-wide expansion of mock codes will include other pediatric units, increasing the use of the on-line module to include all health care workers participating in code blue activities. The pre- and post-test mock code survey will also be modified to factor code blue team roles as a modifying factor. Finally, the formalization of this blended recurring PALS curriculum will satisfy educational gaps in the field of pediatric CPR training.

Conflict of Interest

None of the authors identify a conflict of interest.

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Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants

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Abstract

Prevention is the recommended strategy for addressing childhood obesity and may be particularly important for minority groups such as Native Hawaiians, Pacific Islanders, and Filipinos (NHPIF) who display poorer health outcomes than other race/ethnic groups. Complementary feeding is a critical milestone in the first 1,000 days of life and plays a critical role in growth and eating habit formation. This cross-sectional study recruited NHPIF infants between 3–12 months of age residing on O’ahu, Hawai’i to examine timing and types of complementary foods introduced first as well as the dietary diversity of those infants 6–12 months of age. Basic demographic information and early feeding practices were assessed via online questionnaire. Diet was evaluated using the image-based mobile food record completed over 4-days. Images were evaluated to derive the World Health Organization’s minimum dietary diversity (MDD) score. Data were analyzed using descriptive statistics and linear regressions. Seventy participants completed the study with a majority being between the ages of 6–12 months (n=56). About half of the participants were provided a complementary food prior to 6 months of age with the most common first complementary food being poi (steamed, mashed taro). Grains were the most commonly reported food group while the high protein food groups was the least commonly reported. Approximately 25% of infants 6–12 months of age met MDD all four days. Meeting MDD was significantly associated with age. Findings illuminate opportunities for improvement (eg, delayed introduction) and for promotion (eg, cultural foods) in NHPIF complementary feeding.

Keywords

Dietary complementary feeding, Diversity, Infants

Abbreviations

ANOVA = Analysis of variance

IRB = Institutional Review Board

MDD – Minimum Dietary Diversity

mFR – Mobile Food Record™

NHPIF – Native Hawaiian/Pacific Islander/Filipinos

WHO – World Health Organization

WIC = Supplemental Nutrition Program for Women, Infants and Children

Introduction

Early feeding practices, including the type, timing, and diversity of complementary foods shape long-term eating and health behaviors. This period is linked with rapid growth and likely influences risk for obesity, chronic disease, and other health conditions later in life.¹ Recent data from the Supplemental Nutrition Program for Women, Infants and Children (WIC) found that few infants frequently consumed fruits (14.4%) and

vegetables (7.0%) and 14.0% had no exposure to sugary beverages.² The only assessment of complementary food practices in Hawai’i,³ a location with a high proportion of Native Hawaiians, Pacific Islanders, and Filipinos (NHPIF), found that many infants did not meet complementary food timing recommendations, which is not unlike current national trends⁴ or what has been documented in the Asia Pacific region.⁵

Prevention is a recommended strategy for addressing child obesity and starts with nutrition in the first 1,000 days of life.¹ There are many external influences on infant feeding practices that include personal beliefs, family, socioeconomic status, and culture.⁶ Early feeding may be a significant disease prevention and health promotion stage in life especially for underserved minority populations like NHPIF, who are one of the highest-risk populations in the United States (US) with increased prevalence rates of diabetes, obesity, and cardiovascular risk factors and the poorest healthy life expectancies in comparison to other population groups.⁷⁻⁹ In early childhood, the prevalence of obesity in NHPIF children 2–8 years of age was second only to American Indians and Alaska Natives in comparison to other racial or ethnic groups in the US Affiliated Pacific Region.¹⁰ Data from the largest federally qualified community health center in Hawai’i, which represents a community with a high proportion of NHPIF, found that children who underwent rapid growth between 12 months and 23 months were at the highest risk for child obesity in Pre-Kindergarten.¹¹ Additional data from the Hawai’i WIC found that 17.5% of Samoan children 12 months of age were at or above the 95th percentile of weight-for-age in comparison to 5.9% of white children; moreover, by 2–4 years of age, Samoan children were almost 4 times as likely to have a body mass index at or above the 95th percentile in comparison to white children of the same age.¹² Researchers from those studies hypothesized that overall feeding patterns influenced these findings; however, it is unknown how complementary feeding, ie, foods added to the diet in addition to human milk (or infant formula), have contributed individually to these numbers.

No recent examination has assessed the infant diet quality of NHPIF. Unfortunately, data for NHPIF subpopulations are consolidated into the “other” category in national surveillance summaries. As a result, national monitoring efforts do not allow for meaningful interpretations of NHPIF popula-

tions.¹³ Consuming diverse foods to meet one's nutrient needs is one tenet of a healthful diet. Among infants, Moursi, et al, reported the variety of food groups consumed was found to predict micronutrient density and dietary quality.¹⁴ Similarly, Steyn, et al, reported dietary diversity can act as a simple and quick indicator of the micronutrient adequacy of the diet.¹⁵ A longitudinal examination of infant dietary diversity among an international cohort of urban, predominantly human milk fed infants 6 – 12 months found that infants in Cincinnati (US) had a lower dietary diversity than infants in Shanghai (China) and Mexico City (Mexico).¹⁶

The aim of this study was twofold. First, to examine timing and types of complementary foods introduced first to NHPIF infants ages 3 – 12 months residing on O'ahu, Hawai'i. Second, to examine dietary diversity of those NHPIF infants 6 – 12 months of age. These findings will provide an indication of complementary feeding practices as well as the healthfulness of the infant diet.

Methods

Study Sample

The target population for this cross-sectional study was NHPIF infants between 3 – 12 months of age residing on O'ahu, Hawai'i. The 3 – 12 month age range was selected based on previous research documenting that complementary food introduction occurs as early as 3 months.³ To be eligible to participate, the infant's caregiver(s) had to be 18 years of age or older, have an iOS mobile device, and have reliable access to the Internet. Recruitment for a convenience sample of NHPIF infants was primarily community-based and occurred through community events (eg, Baby Expo), programs (eg, WIC), and networking. Seventy infants and their caregivers completed the study. Institutional Review Board (IRB) exemption from the University of Hawai'i was received prior to the collection of data (IRB reference number: 2017-00845). Consent was obtained in writing from the caregivers for both their participation and their infant's participation prior to collecting any data.

Questionnaire

All caregivers were asked to complete an online questionnaire administered through a research web application about themselves and their infant(s) at study onset. Caregivers reported basic demographic information and early life feeding practices such as timing and type of introduction of complementary food.

Dietary Assessment

Dietary assessment of the infant occurred through surrogate reporting via caregiver with the mobile food record™ (mFR™; Purdue University, 1.2.1firstfoods-MF, Updated January 29, 2019, West Lafayette, IN). The mFR is an application designed

specifically for assessment of dietary intake which uses the camera on a mobile device to capture food and beverage intake, which is then used to estimate energy and nutrient intakes. The use of the mFR has resulted in increased accuracy of diet data collected for children,¹⁷ adolescents, and adults.¹⁸ Adults (18-49 years) are the highest adopters of mobile devices and represent the majority of parents with young children. This study is the first time that an image-based dietary assessment approach has been used with infants.¹⁹ The mFR was loaded on to the caregiver's mobile device and training on the mFR application was completed prior to data collection. Caregivers were instructed to complete a 4-day food record (Thursday – Sunday) using the mFR. They were instructed to take pre- and post-images of all foods and beverages the participant consumed over the 4 day period. Breastfeeding events were recorded with a timer available on the mFR. As this was the first time this method has been applied to infants, study days were selected following previous studies.^{17,20} After the collection period concluded, a member of the research team reviewed the images from the mFR with caregivers to verify content, as needed, and to probe for any forgotten foods or beverages. At the end of the data collection period, caregivers were given a \$40 gift card.

Dietary Diversity Score

Diet quality index scores like the healthy eating index do not currently exist from birth to 24 months due to the US Dietary Guidelines only applying to the population 2 years of age and older. Therefore, the global metric Minimum Dietary Diversity (MDD) score from the World Health Organization (WHO) was used to examine infant diet quality in this study.²¹ To the authors' knowledge, the WHO MDD has rarely been used in developed countries and never in NHPIF populations. To calculate, the number of solid foods and liquids consumed in any amount more than a condiment was counted in the mFR recorded images each day. Using the WHO MDD metric, solids and liquids consumed in a day were categorized into seven food groups: (1) grains, roots, and tubers [grains]; (2) legumes and nuts [legumes]; (3) dairy products (milk, including formula, yogurt, cheese) [dairy]; (4) flesh foods (meat, fish, poultry, liver/organ meats) [flesh]; (5) eggs [eggs]; (6) vitamin A-rich fruits and vegetables [vitamin A FV]; and (7) other fruits and vegetables [other FV]. MDD is predictive of micronutrient density of the infant's diet and considered met if the infant is reported to have consumed four or more of the seven food groups in a given day.²¹ Human milk is not counted in a food group as the WHO MDD metric is examining foods provided in addition to human milk.

Analysis

Descriptive statistics (frequency [percentage], mean [standard deviation (SD)]) were used to summarize the data. The MDD score was calculated as the mean number of food groups recorded across the four days of the mFR. The infants were further grouped by age (3 – 5 months versus 6 – 12 months),

by the mode of feeding (liquids only versus solids only versus liquids and solids), and by liquid food type (human milk versus formula versus both). It has been documented that dietary diversity is inherently different between infants fed human milk versus formula.²² Quantitative variables were compared among subgroups using analysis of variance (ANOVA) methods while categorical variables were compared using Chi-squared tests. The proportion meeting or not meeting the MDD (≥ 4 food groups) was also examined in the participants 6 – 12 months of age subgroup only, across all four days of the mFR with all modes of feeding combined as it is not recommended to compare dietary diversity across mode of initial feeding (eg, human milk or not human milk only). Linear regression was utilized in participants 6 – 12 months of age with age as the independent variable and the number of days meeting MDD as the dependent variable, sequentially adjusting for sex, food assistance, and human milk only consumption. Statistical significance was set at P -value $< .05$. All analyses were conducted in IBM SPSS Statistics Version 25.0 (SPSS Inc: Chicago, IL).

Results

A total of 70 infants completed the study. The majority of participants were between the ages of 6 – 12 months (Table 1). Approximately half of the participants were boys and over 70% were reported as Native Hawaiian or Part Native Hawaiian. Participants came from all regions of the island of O‘ahu. Over 60% of the infants were fed a combination of human milk and formula and slightly over 30% had only been fed human milk. At the time of the study over 50% of infants were still receiving human milk.

About half of the participants were introduced to complementary foods prior to 6 months of age (Table 1). The mean age of introduction was similar across participants fed human milk only, formula only, or both human milk and formula. A traditional Hawaiian dish, *poi* (steamed and mashed taro), alone or in combination with another food item (eg, human milk, infant cereal) was the first most commonly introduced complementary food followed by infant cereal (Table 2).

The images collected in the mFR were examined to count the number of food groups recorded (see Figure 1). With the exception of the dairy food group, complementary foods that were liquid in origin contributed a negligible amount to the food groups consumed by the participants. For both age groups, the legumes, flesh, and egg food groups were not major contributors to dietary diversity. The other FV group was significantly higher for the 6 – 12-month-old group than the 3 – 5-month-old group. The grains and flesh food group were recorded significantly more by the formula-fed only participants in comparison to infants fed both human milk and formula. Participants who consumed human milk only recorded significantly less dairy than infants fed both human milk and formula (Figure 2).

Table 1. Summary of Demographic, Early Infant Feeding and Complementary Food Introduction of Infants 3 – 12 Months (n=70)

Variable	Mean (SD)
Age of the infants in months (n=70)	7.4 (2.1)
	n (%) ^a
Age group	
3 – 5 months	14 (20)
6 – 12 months	56 (80)
Sex	
Boy	38 (54)
Girl	32 (46)
Race/Ethnicity^b	
Part-Native Hawaiian or Native Hawaiian	50 (71)
Pacific Islander only	4 (6)
Part-Filipino/Filipino	35 (50)
Region on O‘ahu participant resided in	
Central	15 (21)
Leeward	12 (17)
North Shore	14 (20)
Windward	12 (17)
Town	17 (24)
Received assistance to pay for food^d	26 (37)
Human milk or formula feeding	
Human milk only	22 (31)
Human milk and formula ^e	44 (63)
Formula only	4 (6)
Currently receiving human milk	40 (57)
Timing of complementary food introduction	
Before 6 months	37 (53)
3 months or Less	4 (6)
4 – 5 months	33 (47)
6+ months	30 (43)
Missing response	3 (4)
	Mean (SD)
Timing of complementary foods in months by milk type	
Human milk only (n=21, missing response=1)	4.9 (1.4)
Human milk and formula (n=42, missing response=2)	5.2 (1.2)
Formula only (n=4)	4.6 (1.3)

^a May not add up to 100% due to rounding

^b More than one race/ethnicity may have been self-selected, therefore will not add to 100%

^c Self-reported Pacific Islander ethnic groups included Chamorro, Samoan, Tongan, Maori, Tahitian, and Micronesian

^d Includes assistance from Supplemental Nutrition Education Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

^e Includes infants who have received infant formula at some point or are currently receiving infant formula

SD = Standard Deviation

Table 2. Frequency of the First Complementary Food Provided to Infants 3 – 12 Months as Reported by Caregivers via Online Questionnaire (n=70)

Food	n	% ^a
Poi (steamed mashed taro with water)	20	29
Infant cereal ^b	19	28
Baby food	7	10
Water	3	4
Avocado	2	3
Carrot	2	3
Response not recorded	2	3
Baby cracker	1	2
Banana	1	2
Banana mixed with juice	1	2
Green beans	1	2
Poi mixed with human milk	1	2
Poi mixed with infant cereal	1	2
Poi mixed with sweet potato and banana	1	2
Rice mixed with eel	1	2
Rice mixed with soup	1	2
Rice, oatmeal, bread	1	2
Sugar water	1	2
Sweet potato	1	2
Sweet potato mixed with banana	1	2
Peas mixed with water	1	2
Pumpkin pie cheese cake	1	2

^a Total may not add up to 100% due to rounding

^b Infant cereal includes responses such as baby cereal and rice cereal

The mean number of days participants 6 – 12 months of age met MDD was 2.0 (SD = 1.6). Girls met MDD on more days than boys (2.6 days [1.5 SD] vs 1.5 days [1.5 SD], respectively, *P*-value = .014 *data not shown*). Only about a quarter (27%) of participants 6 – 12 months of age met MDD for all 4 days with no difference in the proportion meeting MDD by day (Table 3). However, age seemed to be significantly associated with the likelihood of meeting MDD, in all the models considered (Table 4).

Table 3. The Number of Days Infants 6 – 12 Months of Age (n=56) Met the Minimum Diet Diversity (MDD)^a Score by Number of Days and Day of Week

Number of Days Met MDD	n	% ^b
0	15	27
1	10	18
2	5	9
3	11	20
4	15	27
Met MDD By Day of Week ^c	n	%
Thursday	32	57
Friday	29	52
Saturday	26	46
Sunday	26	46

^a Meet MDD is considered met if the infant is reported to have consumed four or more of the seven food groups

^b Numbers may not add up to 100% due to rounding

^c Chi-squared tests were found to not be significantly different between the proportion meeting MDD by day of week ($\chi^2(3, n = 224) = 1.77, P\text{-value} = .62$).

Table 4. Linear Regression Results Examining the Association Between the Number of Minimum Dietary Diversity Days and Age in Infants 6 – 12 Months (n=56)

	Model 1 B (SE)	Model 2 B (SE)	Model 3 B (SE)	Model 4 B (SE)
Constant	-2.08 (0.97)	-3.36 (1.03)	-2.08 (1.23)	-1.78 (1.23)
Age	0.50 (0.12)***	0.49 (0.11)***	0.46 (0.11)***	0.44 (0.11)***
Sex		0.96 (0.35)	0.98 (0.35)	0.97 (0.34)
Food Assistance			-0.65 (0.36)	-0.62 (0.35)
Human Milk				-0.56 (0.37)
R-Squared	0.26	0.35	0.39	0.41
Adjusted R-Squared	0.24	0.32	0.35	0.37

*** indicates *P*-value < .001

Model 1: Age

Model 2: Age + Sex

Model 3: Age + Sex + Food Assistance

Model 4: Age + Sex + Food Assistance + Human Milk

Figure 1a. Solids and Liquids Combined

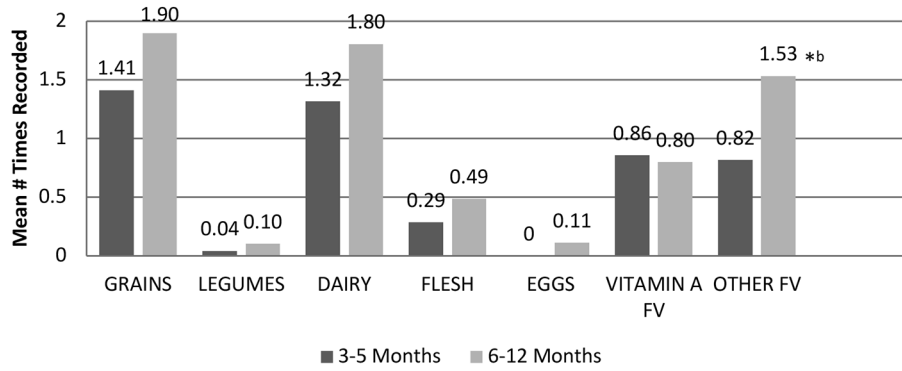


Figure 1b. Solids only

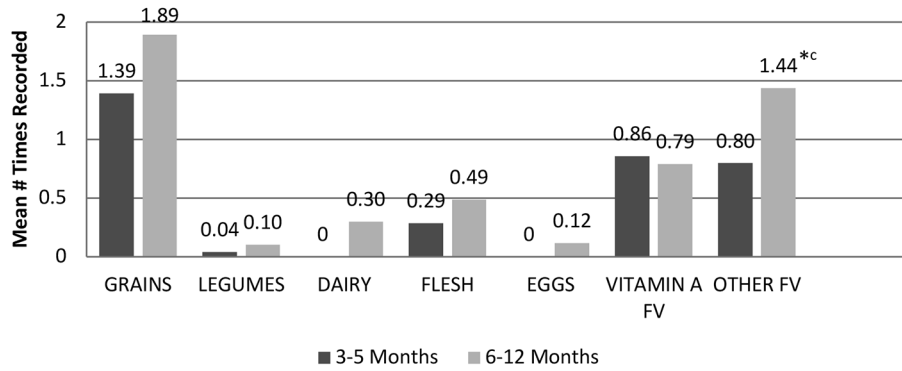


Figure 1c. Liquids only.

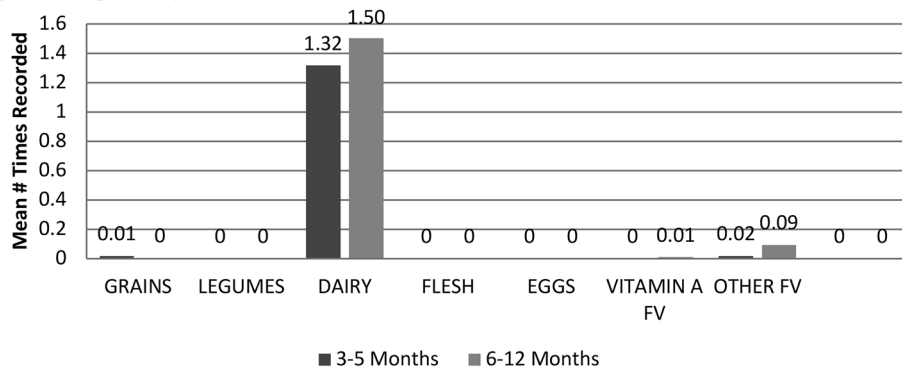


Figure 1. The Mean Number of Food Groups Recorded Across 4 days^a of Infants 3 – 12 Months (n=70), by Mode of Feeding and Age Subgroup.

FV = Fruits and Vegetables

3 – 5 months old n=14, 6 – 12 months old n=56

^a Only 1 participant did not complete all 4 days of the mobile food record (participant was between 3 – 5 months old and only completed 3 days)

^b Infants 6 – 12 months were significantly higher (P -value=.011) than infants 3 – 5 months

^c Infants 6 – 12 months were significantly higher (P -value=.016) than infants 3 – 5 months

* Indicates a significant difference (P -value <.05, based on ANOVA)

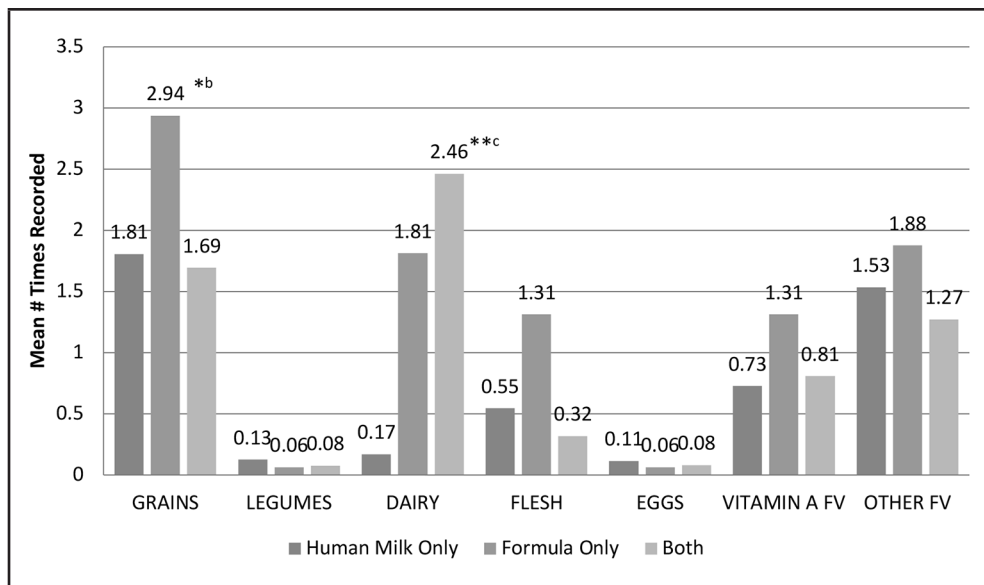


Figure 2. The Mean Number of Solid and Liquid Food Groups Recorded Across 4 days^a by Mode of Feeding (Human Milk Only, Formula Only, or Both) of Infants 3 – 12 Months (n=70)

FV = Fruits/Vegetables

Human milk only n=22, Formula only n=4, Both human milk and formula n=44

^a 1 participant did not complete all 4 days of the mobile food record (participant was between 3 – 5 months old and only completed 3 days)

^b Formula only fed infants were significantly higher (P -value=.036) than infants fed both human milk and formula-fed

^c Infants fed human milk only were significantly lower (P -value=.000) than infants fed both human milk and formula

* Indicates a significant difference (P -value <.05, based on ANOVA)

** Indicates a significant difference (P -value <.001, based on ANOVA)

Discussion

This study is the first to report timing and type of complementary foods introduced specifically in NHPIF infants. Guidelines recommend that infants are not developmentally ready to begin consuming complementary foods until approximately 6 months of age.²³ Nevertheless, similar to a study published in 1995 on complementary feeding practices in Hawai'i,³ this study found that half of the participants were introduced to complementary food prior to this 6 months recommendation.²³ This is consistent with a recent United Nations International Children's Emergency Fund finding that the East Asia and Pacific regions have the highest proportion of infants in the world introduced to complementary food prior to 6 months of age.²⁴ The relationship between the early introduction of complementary foods and obesity is unclear due to studies reporting conflicting results.^{25,26} It has nevertheless been proposed that dietary diversity is one of the 10 recommended approaches to prevent childhood obesity.²⁷

Several studies have documented that a high proportion of infants consume foods from the grains group.^{16,24} This may be of particular significance to Native Hawaiian and Pacific Islanders who attribute significant cultural value to tubers such as taro and sweet potato, classified in the grains group, due to their nutrient composition. For Native Hawaiians in particular, poi

is traditionally considered the perfect first complementary food for infants.²⁸ Indeed, poi, nutrient dense, hypoallergenic, and easily modified to meet a semi-liquid food texture suitable for complementary food,²⁹ was the most common first complementary food in our study. Future studies should consider examining which food(s) within a food group contribute the most to inform future research protocols and health promotion efforts.

The authors found a significant difference in the dairy food group between infants fed formula only or both formula and human milk in comparison to those fed human milk only. Since formula in contrast to human milk is included in the Dairy food group of the WHO MDD metric, there is notable concern that dietary diversity may appear higher for infants fed formula versus those fed human milk.²¹ Accordingly, reaching MDD was not assessed comparing human milk to formula. Recently, the WHO MDD scoring system was updated to include an eighth food group for human milk.³⁰ Unfortunately, this study was completed prior to the publication of the updated WHO MDD metric. In addition, the 2020 US Dietary Guidelines for the first time will include dietary recommendations for pregnancy, infants, and toddlers less than two years of age. Despite these additional guidelines, the development of a diet quality index score for ages 1 – 2 years, like the healthy eating index, is currently unclear.³¹

Another important finding of this study was the low quantity of foods in the high protein groups (eggs, legumes, and flesh), consistent with the findings of a previous study that examined dietary diversity in three international cohorts.¹⁶ As six of the top eight food allergens fall into one of these high protein food groups (eggs, peanuts, tree nuts, fish, shellfish, and soy), the low consumption of these foods may delay the development of food allergies in childhood, as previously suggested.^{32,33} However, recommendations on the timing of the introduction of high allergen foods are now shifting as evidence now suggests that early introduction of these foods will reduce the likelihood of developing a food allergy in childhood.³⁴⁻³⁶ Hence, there is limited clarity in the relationship between dietary diversity and the development of food allergies.^{37,38}

This study is the first to examine dietary diversity in NHPIF infants 6 – 12 months of age. Results are similar to a study on infant diet quality in the US. In that study, the mean number of WHO food groups consumed over a 24-hour period was 2.4 groups for infants 6 months of age.¹⁶ Moreover, only 28% of the infants, ages 8 – 12 months, meet the MDD. However, the study was conducted in a predominately white, urban, US infant population that was primarily fed human milk. This is noteworthy since dietary diversity is significantly influenced by the consumption of human milk.²² The interaction between infant diet diversity and human milk intake is important to consider as more than half of the infants in the present study received both human milk and formula. This additional layer of complexity highlights the need for further exploration of the influences on infant diet diversity.

The association between age and dietary diversity found in this study aligns with other studies documenting a higher proportion of infants at 12 months of age meeting MDD, in contrast to younger infants of 6 months of age.^{16,43} As an infant develops head control, accepts and swallows foods of developmentally appropriate textures, it is instinctively anticipated that the number of complementary foods introduced into the diet will increase.

Finally, this study employed a cross-sectional design to provide data on the timing and types of complementary foods introduced to a cohort of NHPIF infants ages 3 – 12 months, as well as dietary diversity of a sub-sample of infants 6 – 12 months, residing on O‘ahu, Hawai‘i. Hence, the use of a convenience sample may not be representative of the broader racial or ethnic targeted groups. Despite several areas of concern, such as a high proportion of infants being introduced to complementary foods before the recommended six months of age, and a low proportion of infants meeting MDD, the healthy and culturally informed complementary feeding practice of providing poi was identified. Moreover, an innovation employed in the study was the first time use of an image-based dietary assessment tool to enumerate the dietary intake of infants. The use of an image-based dietary assessment approach improves accuracy and reduces the risk of recall bias.¹⁹ Other important factors

to consider when examining infant diet diversity, such as its relationship with obesity in later life,³⁹ was beyond the scope of this study. In addition, the study was limited to caregivers with access to an iOS mobile device. The application used to collect data was of original design, developed only for the iOS platform. Future studies will include other mobile device platforms such as Android. Future studies should also examine dietary diversity of NHPIF infants in more depth with an updated WHO MDD metric using an image-based dietary assessment approach to determine how dietary diversity is associated with other indicators of health such as obesity over a period of time.

Conflict of Interest

None of the authors identify any conflict of interest.

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Chronic Esophagitis and Gastritis After Ingestion of Box Jellyfish (Class Cubozoa)

Benjamin R. Smith MD and Catherine M. Sampert DO

Abstract

This is a case report of chronic esophagitis and gastritis following the ingestion of box jellyfish (*Alatina alata*) by a 12-year old boy with severe autism spectrum disorder and pica. Biopsies taken at esophagogastroduodenoscopy at two months post ingestion revealed histological evidence of esophagitis and gastritis, which resolved after treatment with H2 receptor agonist and proton pump inhibitor.

Keywords

Adolescent, Autism, Esophagitis, Gastritis, Ingestion, Jellyfish, Pica

Abbreviations

ED = Emergency department
EGD = Esophagogastroduodenoscopy
H. pylori = *Helicobacter pylori*
IV = Intravenous
MRA = Magnetic resonance angiography
PPI = Proton pump inhibitor
SBFT = Small bowel follow through
UGI = Upper gastrointestinal series

Introduction

Jellyfish envenomation is a common event in coastal waters with more than 200 reports annually to the National Poison Data System and many more unreported.¹ The most common and frequent symptoms are pain and skin reaction.² Mortality is rare with marine animal and plant envenomation accounting for one death over an eight year period in the United States. Marine and plant envenomation fatalities are a small fraction of the total fatalities caused by all venomous animals which is about 50 deaths annually.³ Almost all jellyfish envenomations occur by cutaneous contact. A literature review found no reports of uncooked jellyfish ingestion, and only two reports of anaphylaxis after cooked jellyfish ingestion.⁴⁻⁶ This is a case report of human ingestion of a venomous jellyfish. Ingestion resulted in acute angioedema, followed by several months of esophagitis and gastritis treated with an H2 receptor antagonist, then transitioned to a proton pump inhibitor (PPI). Studies including esophagogastroduodenoscopy (EGD) with biopsies, upper gastrointestinal radiograph series with small bowel follow through (UGI with SBFT), abdominal ultrasound, and abdominal magnetic resonance angiography (MRA) of abdomen all occurred due to severity and persistence of symptoms. Ingestion was also complicated by constipation treated with polyethylene glycol. Pica is a disorder of recurring non-food

ingestion, and it occurs more frequently in patients with autism.⁷ Consent for publication was obtained from the mother of the patient in accordance with the principals outlined in the Declaration of Helsinki.

Case Presentation

A 12-year old nonverbal boy with severe autism spectrum disorder and pica ingested a jellyfish. Ingestion was witnessed by his behavioral aide while they were free diving at White Plains Beach on O'ahu. The patient was swimming with his behavioral aide when he grasped and ingested a small jellyfish while freediving with only a mask and no snorkel or other breathing apparatus. The patient's behavioral aide escorted the patient to shore where he and the patient's mother saw a few small tentacles still protruding from the patient's mouth. The professional lifeguards as well as the behavioral aide, who is an expert skin diver, identified the jellyfish as *Alatina alata* (Figure 1). This is a venomous box jellyfish (formerly known as *Carybdea alata*) of the class Cubozoa. The patient's mother described a few linear small red marks on the perioral skin. The mother administered 12.5 mg of oral liquid diphenhydramine about 30 minutes after the ingestion. The patient did not appear to have any concerning symptoms and the family returned home. Prior to the jellyfish ingestion the patient was observed ingesting handfuls of sand from the ocean floor while submerged. The sand ingestion was a new behavior discovered on the same day.

Approximately 3 hours-post jellyfish ingestion, the patient complained about mouth pain and was taken to the local emergency department (ED), where his physical examination was notable for glossal edema and difficulty handling his secretions, but without labial edema, tenderness to abdominal palpation, stridor, tachypnea, or dyspnea. He was treated with 25 mg intravenous (IV) diphenhydramine, 125 mg IV methylprednisolone, and 20 mg IV famotidine. However, upon reevaluation 1 hour later in the ED, the patient had difficulty handling secretions with evolving lower labium edema, and evolving maculopapular rash over the mental protuberance. Concern for anaphylaxis and potential upper airway obstruction prompted treatment with intramuscular epinephrine 300 mg. Lower labium edema and the maculopapular rash over the mental protuberance improved and the patient was discharged home. His discharge plan included oral diphenhydramine 37.5 mg every 6 hours, oral famotidine 16 mg every 12 hours, and oral prednisolone 60 mg once a day for 3 days.

After this event the patient had abdominal discomfort for several months. This was attributed to the ingestion and investigated by EGD 2 months post-ingestion that was endoscopically normal while tissue pathology demonstrated esophagitis and chronic gastritis (Figures 2 & 3). Upper gastrointestinal series with small bowel follow through (UGI with SBFT) did not demonstrate reflux. Oral ranitidine 150 mg daily was started prior to the EGD and continued for 1 week before transition to oral omeprazole 20 mg daily. This was transitioned 4 months post-

ingestion to oral lansoprazole 30 mg daily until the repeat EGD 9 months post-ingestion. This EGD was also grossly normal, with histology demonstrating resolution of esophagitis and gastritis (Figures 4 & 5). Alternate etiologies for abdominal discomfort were pursued but unrevealing. UGI with SBFT did not demonstrate reflux or anatomic abnormality to explain his symptoms. The patient was *Helicobacter pylori* (*H. pylori*) negative and MRA of abdomen was normal.

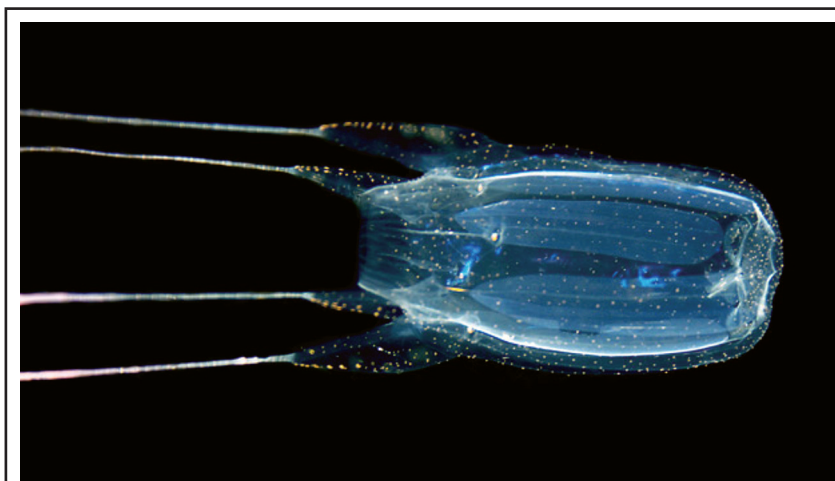


Figure 1. Box Jelly Fish, *Alatina alata*, Size Up to 7.5cm in Height¹⁰
(Photo courtesy of Waikiki Aquarium, University of Hawai'i, Honolulu, HI)

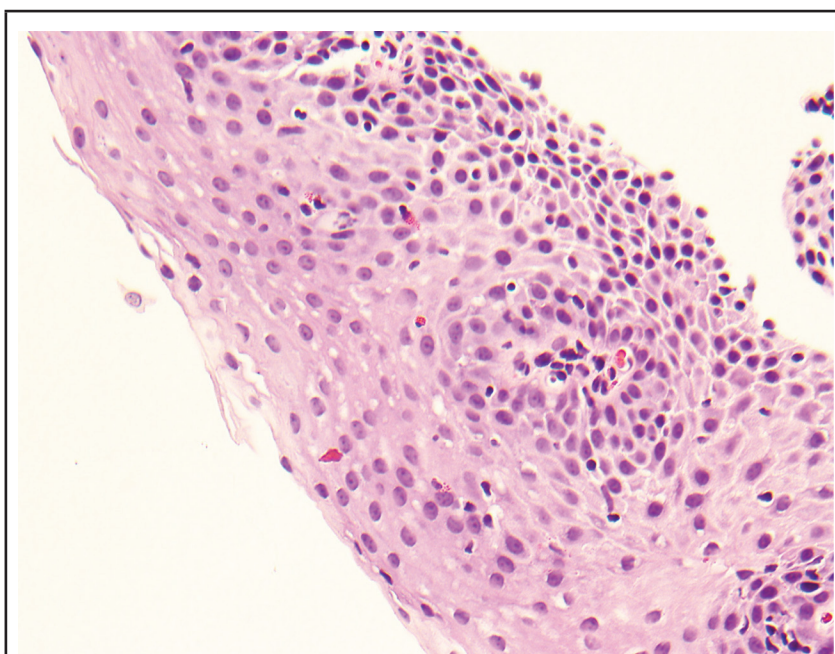


Figure 2. Esophagitis with Scattered Intraepithelial Eosinophils Two Months Post Jellyfish Ingestion

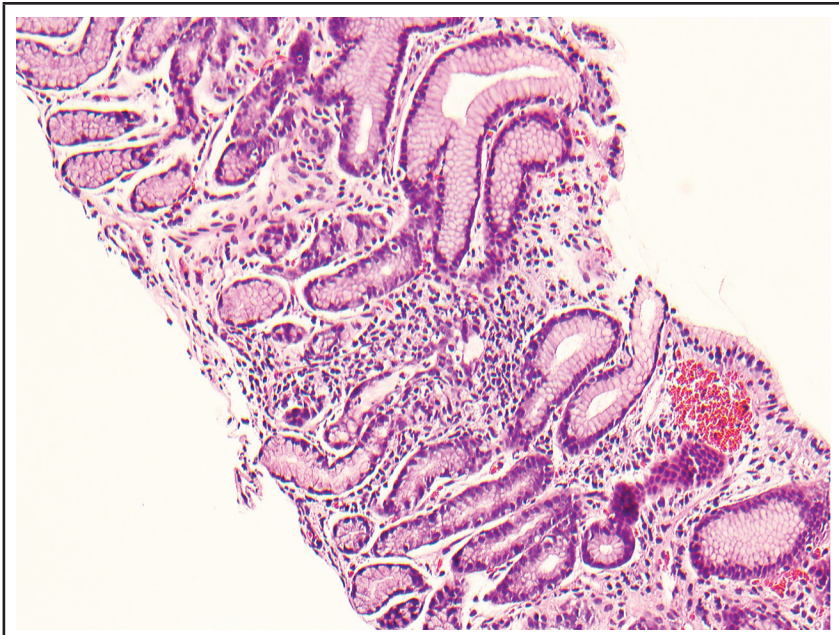


Figure 3. Gastritis with Focal Neutrophilic Infiltrate Two Months Post Jellyfish Ingestion

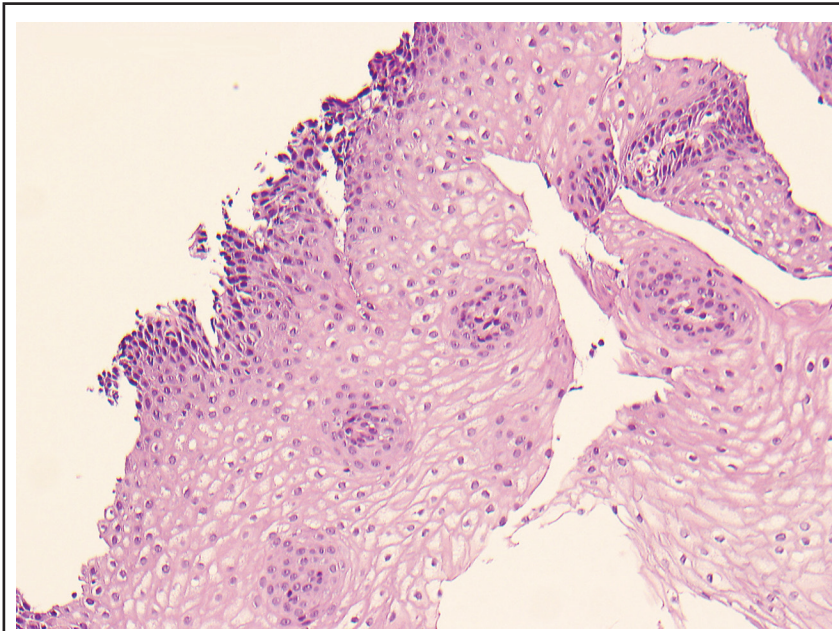


Figure 4. Normal Esophagus Biopsy Nine Months Post Jellyfish Ingestion

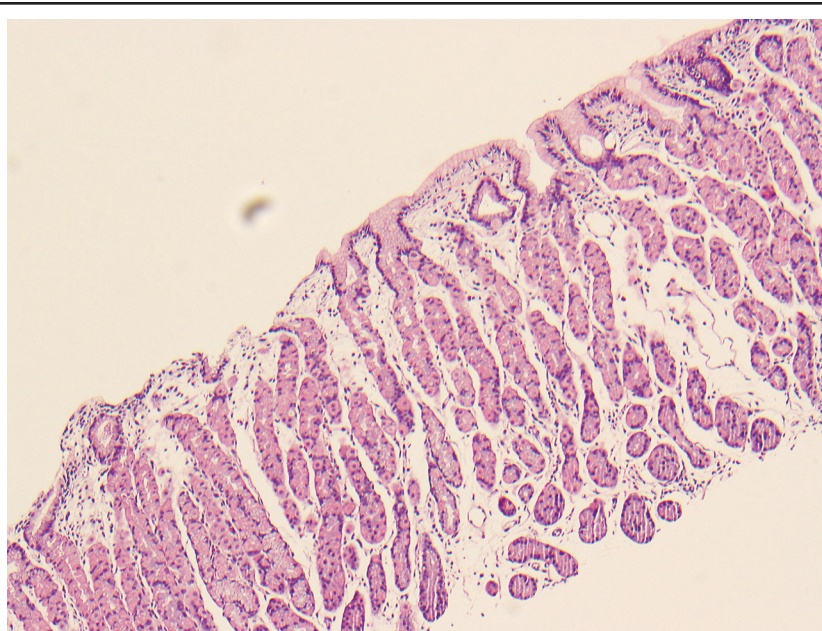


Figure 5. Normal Stomach Biopsy Nine Months Post Jellyfish Ingestion

Discussion

The patient ingested a dangerous venomous animal, likely due to the patient's autism and associated pica. The description of the box jellyfish by the mother and behavioral aide along with its abundance on the southern shores of O'ahu suggests that the most likely identification of the animal was *Alatina alata*.⁸ The team determined that *Alatina alata* ingestion led to chronic esophagitis and gastritis based on tissue pathology at 2 months. They postulated that *H. pylori* was less likely the etiology of the findings given normal UGI, no histology supporting reflux, and negative *H. pylori* test. The patient's chronic esophagitis and gastritis resolved with a long course of PPI. Anaphylaxis and anaphylactoid reactions have previously been described after *Alatina alata* envenomations,⁹ consistent with the patient's acute angioedema. Although the patient also frequently ingested so much sand he had significant constipation related to this, it is unlikely that the patient's sand pica led to the findings that the team attribute to *Alatina alata* ingestion.

The views expressed in this manuscript are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the US Government.

Conflict of Interest

None of the authors identify a conflict of interest.

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kūpuna
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Māori
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