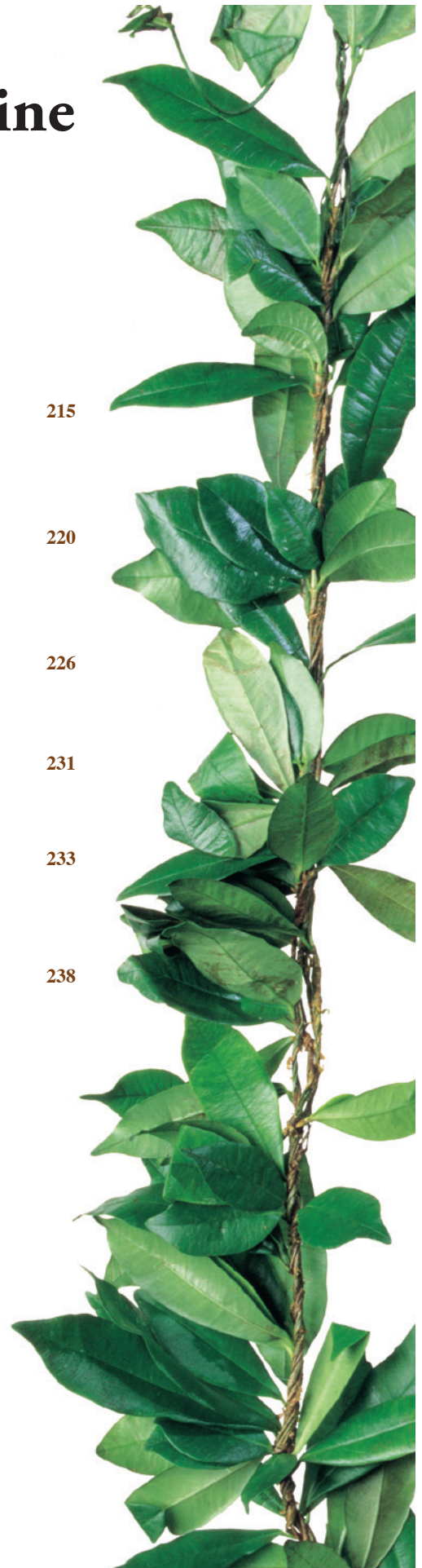


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The Epidemiology of Slipped Capital Femoral Epiphysis in American Samoa

Graham T. Fedorak MD, FRCSC; Amy K. Brough MD; Robin H. Miyamoto PhD; and Ellen M. Raney MD

Abstract

The Maori of New Zealand have been identified as a high-risk population for slipped capital femoral epiphysis (SCFE). This study assessed whether the burden of disease from SCFE in the American Territory of American Samoa is similar to that identified in the Maori. This was a retrospective review of children from American Samoa treated for SCFE at a tertiary care pediatric hospital between 2005-2014. Demographic, clinical, and radiographic information was collected. All patients were followed for at least one year after surgery and prophylactically pinned hips were not included. Data for determining incidence was obtained from the United States Census Bureau. Between 2005-2014, 55 American Samoan youth were treated for 73 SCFE. The incidence in the "at-risk" population 5-14 years of age was 53.1 per 100,000. Patients had a mean BMI of 29.5 (19.4-46.4) and mean weight of 76.7 kg (45.9-139 kg). Southwick angle was a mean 40.6° +/- 20.4° (6-83°). Overall, 82.2% of hips were treated with in-situ cannulated screw fixation. At a minimum one-year after initial surgery, 22 hips (30.1%) required major surgery including intertrochanteric osteotomy, osteochondroplasty, or total hip replacement. The incidence of SCFE in American Samoa is extremely high, 53.1 per 100,000 of "at-risk" population 5-14 years old. The mean weight and BMI in SCFE patients from American Samoa is substantially higher than previously published reports. Furthermore, morbidity from SCFE in this population is substantial with 30.1% requiring major surgery either at the time of physeal stabilization or in subsequent years.

Keywords

SCFE, slipped capital femoral epiphysis, hip disorders, obesity, Polynesian, Samoa

Introduction

Slipped capital femoral epiphysis (SCFE) is a pediatric hip disorder characterized by displacement through the proximal femoral physis leading to variable degrees of deformity, pain and dysfunction. Untreated SCFE can lead to limitations in motion, early degenerative hip arthritis, and increased need for hip arthroplasty. Risk factors for SCFE are described as multifactorial. Weight, race, mechanical stress based on osseous anatomy, and endocrine factors are all thought to be contributors.¹⁻⁸ Among these factors, increased body mass is the most common finding in children with SCFE and its importance is well established.^{2,5,7,8} Other risk factors can often be traced back to increased weight: hormonal changes associated with obesity may weaken the physis;⁹ reduced femoral anteversion, pre-disposing to SCFE, is more prevalent in obese adolescents;¹⁰ and, the simple fact that the mechanical forces across the femoral head with gait are 6.5 times body weight.³

The incidence of SCFE varies between different racial groups, with the Maori from New Zealand demonstrating the highest incidence.^{1,11,12} American Samoa is an American Territory consisting of a group of seven islands located 2,600 miles

southeast of Hawai'i and 1,800 miles northeast of New Zealand. The population in 2010 was 55,636.¹³ Greater than 90% of the population of these islands identify as Polynesian in US Census Bureau statistics.¹³ Given the documented high incidence in the Maori, the incidence in a predominantly Samoan population could be expected to be high. Limited access to healthcare and necessary intra-operative imaging in peripheral hospitals has led to all children diagnosed with SCFE in American Samoa being treated at a tertiary referral hospital in Honolulu, Hawai'i for several decades.

The objective of our study was to determine the incidence of SCFE in American Samoa and compare to previously published data in other populations. Given the long-term disability due to hip dysfunction and arthritis from untreated SCFE, or, SCFE not treated in an expedient fashion, a high incidence of this disorder may warrant increased screening in the susceptible adolescent population.

Materials and Methods

A retrospective chart and radiographic review was conducted of all patients from American Samoa treated for SCFE at a tertiary pediatric orthopaedic hospital in Honolulu, Hawai'i over a ten-year period between 2005-2014. Due to the fact that resources were not available for treatment of SCFE in American Samoa, diagnosis was made by orthopaedic surgeons in American Samoa and patients were transported to Hawai'i for surgical treatment. Charts were reviewed one year after the last surgical case included. Institutional review board approval was obtained from the University of Hawai'i.

In determining incidence and demographic details, if bilateral SCFE were treated asynchronously, only the first side was included. Thus, if a patient presented with a right sided SCFE, but one year later had a left-sided SCFE, only the right side was counted to determine incidence. Parameters assessed in this manner included age, gender, height, weight, body mass index (BMI), medical comorbidities, duration of antecedent symptoms, time between diagnosis and surgery, and family history of SCFE. Radiographic measurements of skeletal maturity were assessed by assessing the Risser status, the revised modified Oxford Bone Score, and status of the triradiate cartilage (open versus closed). Risser status assesses ossification of the iliac apophysis on the pelvis and ranges from 0 to 5. Risser 1 occurs at a mean age of 13.5 years in girls and 15.5 years in boys, at a point when two-thirds of puberty has passed. The revised modified Oxford Bone Score is another measurement of skeletal maturity, based on an AP pelvic x-ray designed to predict the

risk of SCFE on the opposite hip when children present with a unilateral SCFE. A score of 0-2 corresponds to lesser skeletal maturity and a high risk of another SCFE on the opposite hip. In bilateral cases, both hips were assessed independently for laterality, stability, Southwick angle (SA),¹⁴ slip severity, type of fixation, and further surgery. Southwick angle is the most common measurement of hip deformity in SCFE. Mild deformity is defined as a SA < 30°, moderate deformity SA is 30-50° and in severe deformity the SA is > 50°. Further surgery was subdivided into minor (including irrigation and debridement, screw revision, screw removal) and major. Prophylactically pinned hips were not included.

Data to calculate incidence was obtained from the United States Census Bureau.¹³ Year-by-year data was available with the population of American Samoa split into 5-year age groups: 0-4 years, 5-9 years, 10-14 years, and 15-19 years. Given the heterogeneity of the calculation of incidence in previous studies, incidence was calculated for the following groups: 5-14 years or the “at-risk” population as defined by Phadnis, et al,¹¹ 5-19 years, and total population to allow comparison.

Statistical analyses included descriptive statistics, and chi-square or independent sample t-tests to assess gender differences for each study parameter as described above using SAS 9.3 (SAS Institute Inc, 2011-2012).

Results

Patient Population

Between 2005-2014, 55 American Samoan patients were treated for 72 SCFE. All patients were Samoan. Demographic details of the study sample are presented in Table 1. Thirty-seven patients were male (67.3%) and 18 were female (32.7%). Mean age at treatment was 12.3 years (+/- 2.2, 7.3-18.1). BMI was a mean of 29.5 (19.4-46.4) and mean weight was 76.7 kg (45.9-139 kg). The left and right hip were equally involved: 37 left, 35 right. Bilateral SCFE, either on presentation, or at a later date, were present in 30.9% of patients (n=17). Four hips were unstable

(5.5%) and two patients had medical conditions predisposing to SCFE – panhypopituitarism and a pituitary tumor (data not shown). Seven children had a first degree relative with a history of SCFE requiring treatment. Weight percentiles of female and male patients were based on World Health Organization data and categorized into the following percentiles: greater than 99th (n=25, 45.5%), 97th-99th (n=17, 30.9%), 90th-97th (n=6, 10.9%), 75th-90th (n=4, 7.3%), and less than 75th (n=3, 5.5%) (Figure 1).

Twenty-five patients described a history of acute SCFE (45.5%, defined as antecedent symptoms of three weeks or less) and mean duration of antecedent symptoms, prior to radiographic diagnosis, was 43 days (0-60 days) (data not shown). There were four unstable slips, one of which proceeded to avascular necrosis. The remaining, stable patients were given crutches at the referral hospital and advised to limit weight-bearing until transport on a commercial flight could be arranged for treatment at our facility. Radiographic indicators of skeletal maturity derived from pelvic X-rays at the time of treatment are presented in Table 2. Risser status was 0 in 87.3% (48/55) of patients, and 32.7% of patients had an open triradiate cartilage (18/55). Revised modified Oxford Bone Score was 0-2 in 45.5% (25/55) and 3-10 in the remaining 54.5%.

Table 1. Demographic Information of Study Sample	
Demographics (n=55)	
Male / Female (n, %)	37 (67.3%) / 18 (32.7%)
Mean Age (years), range	12.3 years (+/-2.2, range 7.3-18.1)
Mean Body Mass Index (kg/m ²), range	29.5 (19.4-46.4) kg/m ²
Mean Weight (kg), range	76.7 (45.9-139) kg
Yes, family history of SCFE	7 (55%)
Slipped capital femoral epiphysis (n=73)	
Unilateral / Bilateral	55 (76.4%) / 17 (23.6%)
Right / Left	37 / 35

SCFE, slipped capital femoral epiphysis

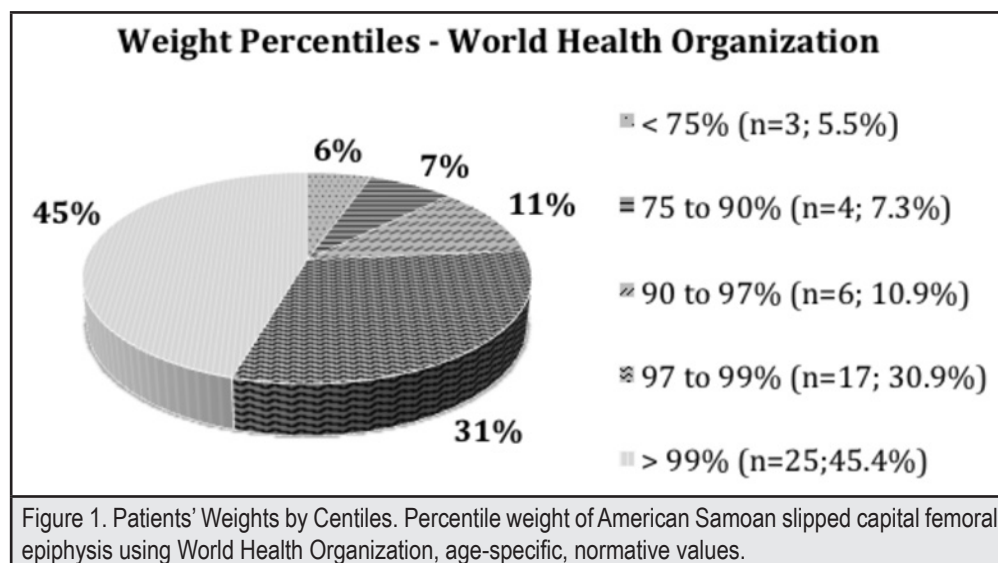


Figure 1. Patients' Weights by Centiles. Percentile weight of American Samoan slipped capital femoral epiphysis using World Health Organization, age-specific, normative values.

Radiographic Deformity and Treatment

Mean Southwick angle was 40.6° (+/- 20.4°, 6-83°) with the distribution of mild, moderate and severe slips being relatively equal. Twenty-six SCFE were mild (SA < 30°, 36.1%), twenty-four were moderate (SA 31-50°, 33.3%) and twenty-two were severe (SA > 50°, 30.1%) (Table 3). Fifty-nine of seventy-two hips (81.9%) were treated with either a single (n=56) or multiple (n=3) cannulated screw(s). Due to severity of deformity, the initial surgical procedure included in-situ cannulated screw fixation with simultaneous intertrochanteric osteotomy in eleven hips (15.3%), intertrochanteric osteotomy alone in one hip presenting late (1.4%), and modified Dunn sub-capital realignment in one hip (1.4%) (Table 4).

Minor additional future surgery was performed in five patients including screw removal (3 patients), hematoma irrigation, and revision screw fixation for failure of physeal closure. Major future surgery was performed in ten patients including

intertrochanteric osteotomy (7), osteochondroplasty (1) and total hip replacement (2). Avascular necrosis occurred in two patients, one stable, one unstable, both of whom underwent total hip replacement. Combined with those who underwent intertrochanteric osteotomy primarily at the time of physeal stabilization, 22 of 73 (30.1%) hips required significant surgery.

Incidence

The incidence of SCFE in the “at-risk” population, 5-14 years old, between 2005-2014 was 53.1 per 100,000. Among 5-19 year olds, the incidence was 33.6 per 100,000. Incidence calculated for the total sample was 10.1 per 100,000. Figure 2 demonstrates changes of incidence over the study period. The “at-risk” population, 5-14 years of age demonstrated a trend towards increasing incidence over the study period, but there were outlier years (2008, 2012) in which the annual incidence was substantially lower.

Discussion

The incidence of SCFE in American Samoan children aged 5-14 is extremely high, 53.1 per 100,000. Based on self-reported US Census Bureau data, the population of American Samoa is 92.6% Polynesian, 95.2% at least partially Polynesian, with 88.9% of individuals specifically self-identifying as Samoan.¹³ This data adds specific information regarding the incidence of SCFE in Samoan children and also to the limited reports regarding Polynesian populations in general, a group that is growing rapidly in the United States.

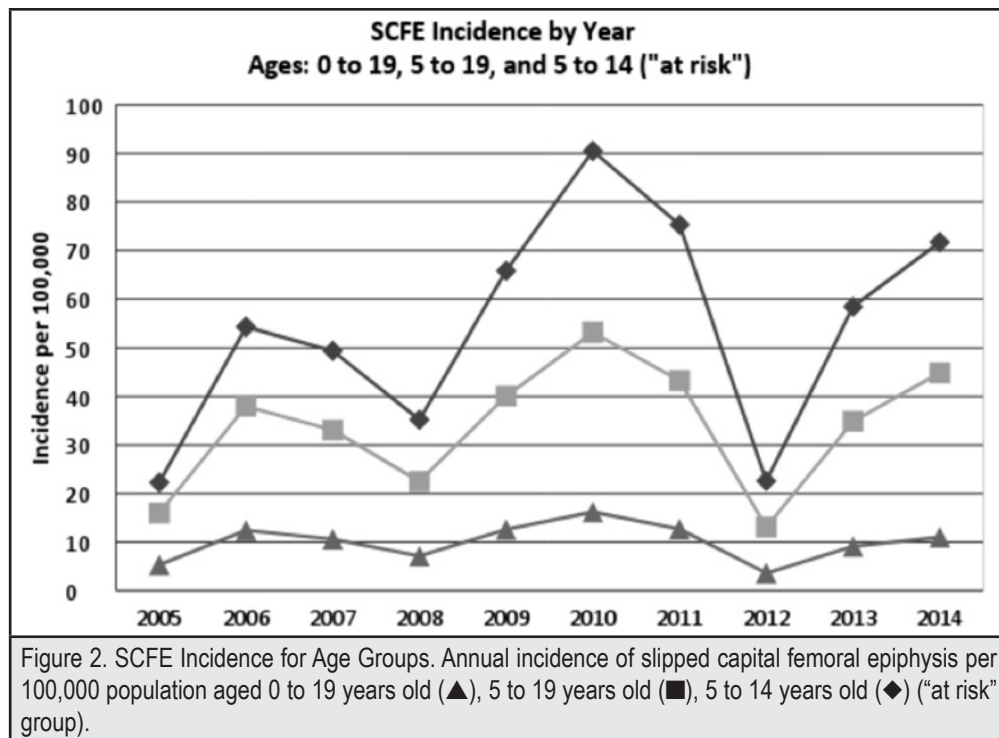
Few studies have reported an increased risk of SCFE in Polynesians, previously exclusively in the Maori of New Zealand. Loder coordinated a worldwide, multi-collaborator study, in which he determined the relative racial frequency of SCFE in Polynesians to be 4.5 times that of the Caucasian population.¹ However, in this study of 1615 children in whom race was known, the group characterized as Polynesian/Native Australian consisted of only 28 Maori and 6 Australian aboriginal children, the latter of which is a distinct group from Polynesians. Stott and Bidwell followed up Loder’s findings, reporting on the children treated for SCFE at Starship Children’s Hospital in New Zealand between 1988-2000.¹² Compared to Caucasian children, children of Maori descent were 4.2 times, and those of other Pacific heritage 5.6 times, more likely to be admitted for SCFE.

Phadnis’, et al, described the highest incidence of SCFE yet reported, in a New Zealand health district with a 22% Maori population.¹¹ Incidence in the Maori population among children 5-14 years of age was 81 per 100,000 compared to 11.3 per 100,000 in Caucasian children, or a relative risk of 7.17. In Maori males, incidence was 94.9 per 100,000. This is the only study describing a group with an incidence of SCFE higher than what is described in the present study among American Samoans.

(N=55)	Radiographic indicators associated with younger skeletal age	Radiographic indicators associated with greater skeletal age
Risser Status (0 vs 1-5)	Risser 0: 87.3% (48/55)	Risser 1-5: 12.7% (7/55)
Tri-radiate cartilage status (open vs closed)	Triradiate Open: 32.7% (18/55)	Triradiate Closed: 67.3% (37/55)
Revised Modified Oxford Bone (RMOBS) Score (0-2 vs 3-10)	RMOBS 0-2: 45.5% (25/55)	RMOBS 3-10: 54.5% (30/55)

Deformity-Southwick Angle – SA	Number (%)	Mean Southwick Angle (range)
Mild (SA < 30°)	26 (36.1%)	19.9° (6-30°)
Moderate (SA 31-50°)	24 (33.3%)	44.7° (31-50°)
Severe (SA > 50°)	22 (30.6%)	65.9° (52-83°)
Overall	72 (100%)	40.6° (6-83°)

Treatment	Number (%)
Single Cannulated Screw	56 (81.9%)
Multiple Cannulated Screws	3 (4.2%)
Cannulated Screw(s) and Intertrochanteric Osteotomy	11 (15.3%)
Intertrochanteric Osteotomy	1 (1.4%)
Modified Dunn Sub-Capital Realignment	1 (1.4%)
	72 (100%)



Polynesians, particularly Samoans and Native Hawaiians, are a large and rapidly growing group in the United States. The 2010 US census shows 1.2 million individuals who self-identify as Native Hawaiian/Pacific Islander alone, or, in combination.¹⁵ This group grew by 40% as compared to the 2000 census, a rate four times that of the general US population over the same span.

While risk factors for SCFE are described as multi-factorial, weight is thought to be the most consistent contributor.^{2,5,7,8} In the adult American Samoan population, 74.6% are classified as obese (BMI ≥ 30),¹⁶ while 84% of Samoan males living in the continental United States are obese¹⁷ as compared to 36% of the US adult male population as a whole.¹⁸ Forty-four percent of American Samoan kindergarten children were identified as overweight/obese (BMI > 25), progressing to 71.3% by the 11th grade.¹⁹ With a mean weight of 76.5 kg and BMI of 29.5, our cohort of SCFE patients is fully 10 kg heavier than previously published SCFE studies, and the BMI is 3.5 kg/m² greater.^{1,11,20} More than three quarters of this group was greater than the 97th percentile body weight for age.

While our cohort was substantially heavier than those of previously published reports, our patients were relatively typical in terms of their age, male-to-female ratio, and degree of slip.^{1,2,7,8,11,12,20-24} Overall, 5.5% of slips were unstable, consistent with other series, one of which developed AVN (25%).²⁵⁻²⁷ Interestingly, the external rotation deformity created by SCFE is culturally well-accommodated in Samoa by traditional practices of sitting cross-legged on the floor as it makes this sitting position easier.

Despite our hospital being the sole referral center for chil-

dren with SCFE from American Samoa, our findings likely underrepresent the incidence of SCFE in this region. Though an American Territory, some cases likely go untreated and American Samoa continues to have difficulties with access to care and education surrounding SCFE. Some of these challenges are reflected in the length of time between diagnosis and treatment for our patients. Furthermore, children with parents from the independent nation of Samoa (formerly Western Samoa) may have been unable to easily travel to the United States for treatment due to parental visa restrictions, and may not have had treatment, or, travelled to Samoa for treatment. Delay and difficulty with transportation is reflected in only 82.2% of hips undergoing in-situ cannulated screw fixation, as compared with eleven (15.1%) which underwent a concomitant intertrochanteric osteotomy, and one case in which delay was substantial enough that the physis was closed by the time of arrival. The 30.1% rate of significant surgery, either primarily or subsequently, reflects the morbidity of this condition in this population, and, further emphasizes access to care challenges.

The retrospective nature of our study is a weakness, as is the question of what age groups one uses to calculate incidence. Previous studies' parameters are a reflection both of the age group at risk for SCFE but also the information available to those authors. Loder reported a mean age of 12 +/- 1.5 years for girls and 13.5 +/- 1.7 years for boys¹ and 76.7% of our patients fell within the classic 10-14 years of age. Previous literature variably utilizes 5-14 years¹¹, 9-16 years^{20,21} 7-16,²² < 25,²³ 7-18²⁴ and other partitions. To facilitate comparison to other studies, we provide incidence utilizing the 5-14 and 5-19 year populations and total population.

Conclusions

Our study demonstrates that the American Samoan population has the second highest incidence of SCFE worldwide, and yet the incidence is likely an underestimate. This rapidly growing demographic group has higher rates of obesity in the continental United States than in American Samoa, and thus great vigilance is recommended when assessing Samoan or any Polynesian youth with lower extremity pain or limp. Current efforts are underway to increase awareness of SCFE in American Samoa and facilitate timely treatment to improve outcomes.

Conflict of Interest

None of the authors identify any conflicts of interest.

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Assessment, Education, and Access: Kona Hawai'i WIC Oral Health Pilot Project

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Abstract

The Kona WIC oral health pilot project was developed to assess the oral health beliefs and behaviors of parents of children and pregnant women at the Kona WIC site and to demonstrate the ease of providing oral health education to families in order to improve oral health behaviors. Data were collected from 50 families about the oral health behaviors and dental care of a total of 73 children, including 5 pregnant women, four of whom had a child enrolled in WIC and one pregnant woman without any previous children. Data revealed that 68% of children with teeth had been seen by a dentist within 6 to 12 months of the study visit. Mothers were seen less often, with 55% stating that they had not been seen for a dental visit for over one year. Parental knowledge about the effects of fluoride on teeth was limited; however, 90% of the parents would allow fluoride varnish applied to their child's teeth, 88% would give daily fluoride drops/tablets to their child, and 78% would support water fluoridation if it would help to improve their children's oral health. Additionally, for children old enough to receive fluoride supplementation, 60% were not given a prescription by their health care providers, and 58% had not received any fluoride varnish applications. By offering oral health education in a WIC clinic and assisting clients to seek out comprehensive care within a dental home, children and caregivers can be provided essential education and resources early in a child's life or women's pregnancies to reduce poor oral health outcomes.

Keywords

WIC Clinics, Oral Health, Hawai'i, Education

Introduction

The 2000 United States (US) Surgeon General's report on oral health highlighted the burden of oral diseases nationally, with particular attention paid to the pediatric population's vulnerability to dental decay. The report details the extent of this preventable infectious disease noting that dental caries is the most common chronic childhood disease, occurring 5 times more often than asthma¹. Despite the existence of dental coverage, including Medicaid and the State Children's Health Insurance Program (SCHIP), children living in poverty continue to be less likely to access preventive dental services compared to their more affluent peers.²⁻⁴ According to a Pew Charitable Trust report,⁵ of the 29 million children enrolled in Medicaid nationally, only 12.9 million received dental care, with the major limiting factor being the inability to access a provider. Within the year 2014 alone, more than 18 million low-income children in the US did not receive any preventive or restorative dental care.⁴

Oral Health in Hawai'i

Hawai'i received a grade of "F" in three recent years from the Pew Center on the States,⁵ when compared to other US states based on key oral health measures. Recently, the Hawai'i

State Department of Health (HDOH) third grade oral health surveillance report revealed that more than 7 out of 10 third graders (71%) experienced tooth decay, with 22% of them having untreated decay.⁶ In addition, during 2011-2012, 29% of low-income children ages 1 to 17 years in Hawai'i had dental problems 6 months prior to the time of data collection, compared to 13% of the higher-income children.⁷

Hawai'i also faces several other challenges to accessing oral health services. Geographical challenges contribute to limited access to dental care particularly for those residents living on islands other than O'ahu. Children living in Kaua'i, Hawai'i and Maui counties (all considered rural areas of the State) have been documented to have more tooth decay than children living in the largely urban Honolulu County, O'ahu.⁶ The third-grade oral health surveillance report also identified oral health disparities in children based on their race/ethnic background, with Micronesian and other Pacific Islanders having the highest prevalence of untreated decay.⁶ Compounding the problem is the lack of a dental school in the State, which further reduces access to dental services; and the lack of community water fluoridation for the majority of the regions of the State, with only those living on military bases (ie, 11% of the State's population) receiving the benefits of water fluoridation.

There are equally disturbing oral health outcomes for Hawai'i's adult population, particularly those from lower socioeconomic backgrounds. Starting in 2009, dental coverage for adults with Quest (ie, Medicaid) insurance was changed to only cover emergency dental care. This resulted in a further decline in the number of high-risk adults seeking preventive dental care, thereby, placing them at additional risk for developing dental decay and the adverse oral and systemic outcomes associated with periodontal disease. Moreover, reports from the Hawai'i Pregnancy Risk Assessment Monitoring System (PRAMS) indicated that only 41% of pregnant women reported seeing a dentist during their pregnancy,⁸ although there is ample evidence in the literature noting the importance and safety of dental care during pregnancy to reduce associated perinatal complications.^{9,10}

These reports have resulted in an urgent call for innovative strategies to improve access to preventive oral health care for children and pregnant women. These strategies include enhancing the oral health education of health care professionals, encouraging the participation of non-dental health care professionals in oral health education and preventive interventions, and expanding the roles of dental hygiene professionals.

WIC and Oral Health

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is well known for its conveniently located clinics in communities where families with young children and pregnant women receive health and nutritional services, education, and assistance accessing other health and social services.^{11,12} It is founded on a philosophy of health promotion education and activities, making it an ideal environment to include oral health education to reinforce good oral health habits in the home and assist families in successfully accessing dental care.

The introduction of oral health education into WIC clinics is not a new idea as it has been implemented in WIC clinics throughout the country.¹³⁻¹⁷ Positive outcomes have been associated with WIC clinics' integration of oral health education including changes in oral health beliefs and behaviors for children and their families, increased rates of accessing preventive dental services in the community, and a reduction in early childhood caries.^{12,13,18} Oral health services in WIC clinics can also help pregnant women overcome some of the common barriers to accessing dental care by increasing their awareness about the importance of oral health, providing information about dental insurance, and referring them to dentists who are comfortable treating pregnant women and young children.¹¹

Kona WIC Oral Health Pilot Project

The oral health initiative for the Kona WIC site was developed as a pilot project and a first step in the development of a simple and efficient solution to the problem of increasing parent's/guardian's knowledge about the importance of oral health behaviors and care, thereby reducing dental disease and its associated complications in pregnant women, children, and families. The Kona WIC site provides services to approximately 600 to 700 clients (ie, pregnant women, children under five years of age) per month.

The key components of the oral health pilot project were based upon reports in the literature of previous US programs' success in utilizing WIC clinics for early oral health education and early entry into dental care for high-risk populations.^{12,13,18} Two faculty members at the University of Hawai'i at Manoa Department of Nursing (UHM DON) developed and implemented the pilot project at the Kona WIC site, including the development of educational materials.

The Kona WIC site was chosen because of its experience in oral health education and existing dental health activities through the Keiki Dental Days program. The Keiki Dental Days program occurs monthly with dental providers from the West Hawai'i Community Health Center performing oral health assessments, applying fluoride varnish, and most importantly enrolling children into their community dental clinic for future preventive, and if needed, restorative care. The Kona WIC oral health pilot project was developed to enhance these services to pregnant women and mothers of children enrolled in WIC so that ongoing oral health content could be part of the WIC staff's education when the Keiki Dental Days dental providers

were not onsite at the WIC clinic (ie, the majority of WIC clinic days).

Project Goals

The UHMDON faculty identified goals for the pilot project were approved by the HDOH Family Health Services Division and WIC Services Branch prior to the pilot project's implementation. The goals included documenting: (1) current oral health education and materials; (2) oral health beliefs and behaviors of Kona WIC clients; and (3) identifying any existing barriers to dental care access for families seen at the Kona WIC site. The overarching aim was to create a WIC oral health education and dental referral model that was time efficient, sustainable, and culturally appropriate for the ethnically diverse group of women enrolled in the Kona WIC clinic.

Methods

Program materials were developed based on a review of the literature documenting the recommended education and practices for integrating oral health into WIC clinics, with approval obtained through the University of Hawai'i (UH) Committee on Human Studies (CHS) and the HDOH Institutional Review Board. The project consisted of a total of six visits to the Kona WIC clinic. The targeted sample size for the pilot was 100 parents or guardians of children or pregnant women that currently attend the Kona WIC clinic. Data collection occurred over a total of 5 to 6 days of routine WIC clinic scheduling. The first visit was a meeting of the WIC clinic staff to: (1) complete an education plan for the staff about oral health needs of young children and pregnant women in Hawai'i; (2) the project details including the educational materials; and (3) address the staff's questions and/or concerns. During the subsequent five visits, the nursing faculty enrolled WIC clinic clients into the study. Sixty WIC clinic clients were asked by one of the front staff members if they would be interested in participating in a study about oral health which included a short survey, education, and the provision of dental supplies to them and their family members at the completion of the education session. Clients interested in participating in the study were provided the informed consent form(s), and once consent was obtained, they completed the oral health questionnaire(s). Two questionnaires were available for completion based on whether the participant was a pregnant woman and/or mother/parent/guardian of a child. The questionnaires were developed based on the results of previously published studies that provided validity and reliability of the questions that were included in the questionnaire,^{19,20} as well as feedback obtained from several members from the Hawai'i Department of Health and State and national dental experts. The questionnaires elicited information about the women's/children's demographics, oral health beliefs and behaviors, and access to dental care in the community. Racial and ethnicity classifications were obtained by self-report and respondents could select as many categories as they felt appropriate. Multiple responses to the questions about racial/ethnic identity were reported and included as non-white, such as "Other Pacific Islander and

Hispanic” or “four or more” where applicable, with exception to Hawaiian for which all respondents self-identified as Native Hawaiian were included as Hawaiian. Upon completion of the questionnaire(s), oral health education was provided using the materials developed for children and pregnant women. Incentives for participating in the program included home dental care supplies for each family member. In addition, dental provider contact details were given to families who had not been seen by a dental provider in the past six months or had no identified dental provider.

Staff feedback about the project was obtained throughout the duration of the project. Based on staff concerns over the perceived time required to integrate oral health education into the WIC clinic visits and the sustainability of the project, the duration of the educational session was recorded for each client.

Descriptive analysis of clients’ responses to questionnaire items was done using SPSS® version 23. Analysis was completed and frequencies for the responses to each of the questions within the oral health questionnaire were calculated based on the family’s response as well as the responses for each individual child in the family.

Results

The project sample consisted of 50 parents/guardians that included 4 pregnant women who had a child currently enrolled in the WIC clinic for services as well as other children in the family, and one pregnant woman who was a primigravida. This resulted in data collection from 49 parents/guardians about the oral health care for 73 children. The information obtained included all children in the 49 parents/guardians whether or not they were currently enrolled in WIC. The children’s ages ranged from 1 month to 14 years, with 16 (22%) identified by their parents as being 6 months of age or less; 11 (15%) were 7 to 12 months; 13 (18%) were 13-24 months of age; 21 (29%) were 25-60 months; with the remaining children (n=12, 16%) reported to be older than 60 months (data not shown). Due to the small number of pregnant women participating in the project, responses from the completed perinatal questionnaires were not included in this analysis.

Of the 49 parents/guardians who responded to the questionnaire, almost one-half (49%) were between the ages of 20-30 years, 37% were between 31-39 years, 10% were >39 years and 4% were noted to be < 20 years old (Table 1). More than a third (37%) of parents/guardians identified as being Native Hawaiian or Pacific Islander, followed by 31% Caucasian, 16% Filipino or Other Asian, 4% as American Indian or Native Alaskan, with 8% noting that they identified with four or more different cultural groups including Native Hawaiian. Also, almost a third (31%) noted that they were of Hispanic ethnicity. In addition, two thirds of the children (71%) were cared for by parents who had a high school or less than high school education.

Parents were then asked about the degree of importance of their child’s baby teeth in comparison to their permanent (adult) teeth. Most respondents (96%) stated that their children’s baby teeth were extremely important, while 4% stated they felt their

child’s baby teeth were moderately important compared to their adult teeth (data not shown). Parent’s knowledge of fluoride was found to be limited with almost half (43%) stating that they had no knowledge about fluoride, while 41% stated that it was good for the teeth or strengthened the teeth (data not shown). Only a small number acknowledged having heard negative information about fluoride.

Three questions were included in the questionnaire to assess parents’/guardians’ willingness to have their children receive fluoride supplement (Table 2). The parents’/guardians’ responses to these questions indicate their willingness to provide fluoride supplements to their children based on the known benefits. Specifically, the majority of parents/guardians (90%) would allow their children to have fluoride varnish applications 2 to 3 times a year; 88% would give fluoride daily drops or tablets to their children; and 78% of the parents would support water fluoridation in Hawai’i.

Despite the positive response to fluoride supplementation,

	Frequency	Percent (%)
Parent/Guardian Age		
< 20 years	2	4
20-30 years	24	49
31-39 years	18	37
> 39 years	5	10
Current Relationship		
Married	26	54
Divorced	3	6
Never married	10	21
Separated	1	2
Living with partner not married	8	17
Unknown	1	--
Ethnicity		
Hispanic, Latino	15	31
Non-Hispanic, Latino	34	69
Race		
White	15	31
American Indian/Alaska Native	2	4
Native Hawaiian	14	29
Other	2	4
Filipino	6	12
Other Asian	2	4
Other Pacific Islander	4	8
Four or more	4	8
Highest level of education completed		
Less than high school	7	14
High school	28	57
Associate degree or some college	9	18
Bachelor's degree	5	10

not all parents were brushing their children's teeth with fluoride toothpaste, or they were not certain if the toothpaste they used contained fluoride. Additionally, for those children old enough to receive fluoride supplements (ie, >6 months of age), 60% were not given a fluoride prescription by their medical or dental provider, and 58% of the children had not received fluoride varnish (Table 3). Of those children old enough to receive preventive dental care, 68% were reported by their parents/

guardians to have been seen by the dentist during the past 6 to 12 months, 5% had been seen 1 to 2 years previously, and 27% had never been seen for a dental assessment (data not shown). Conversely, mothers reported being seen less often, with over half (55%) without a dental visit for over one year, of which 25 % stated they has not been seen for over two years (data not shown).

Discussion

Table 2. Parents' Willingness to Provide Fluoride Supplementation to the Family (n=49)		
	Frequency	Percent
Child fluoride drops and tablets could prevent half of your child's cavities. What would you think about giving your child fluoride drops or tablets every day until age 16?		
Would definitely give it	43	88
Does not want to give it	6	12
Painting fluoride on your child's teeth 2-3 times a year could prevent half of your child's cavities. What do you think about having a dentist, dental hygienist, pediatrician or nurse practitioner painting fluoride on your child's teeth 2-3 times a year?		
Would definitely allow it	44	90
Does not want it done	5	10
Adding a few drops of fluoride to the public drinking water would prevent half of your child's teeth cavities. What do you think about the State of Hawai'i adding fluoride to the public drinking water?		
Want it	38	78
Does not want it	11	22

Table 3. Parent's Oral Health Beliefs and Behaviors for each Child (n=73)		
	Frequency	Percent
Do you use fluoride toothpaste to brush your child's teeth?		
Yes, I use fluoride toothpaste	35	70
No, I use toothpaste without fluoride	6	12
No, I do not use toothpaste at all	7	14
I am not certain if the toothpaste has fluoride in it	2	4
N/A (has not cleaned teeth or child does not have teeth yet)	23	--
Has your child's pediatrician prescribed fluoride drops or tablets for your child?		
Yes	25	40
No	38	60
N/A < 6 months of age	10	--
Has your child ever had fluoride varnish applied to their teeth?		
Yes	25	42
No	35	58
N/A < 6 months of age or no teeth	13	--

The results of this pilot project at the Kona WIC clinic provided previously undocumented information about an ethnically diverse group of clients' oral health knowledge, beliefs and behaviors. Information was obtained about the practices of dental and medical providers in terms of preventive interventions for children's oral health. In addition, the majority of participants reported a lack of parental/guardian knowledge about the benefits of fluoride for reducing caries risk in children. However, once the parents/guardians gained knowledge about the benefits of fluoride for their children, the vast majority wanted this option to be available to them. More than half of the parents/guardians reported that their children who were eligible for fluoride drops or tablets had not received a prescription from their children's dentist or pediatric health care provider. Similarly, participants reported that the majority (58%) of children eligible for fluoride varnish applications had not received these by their dentists and none of the children's primary pediatric health care providers had applied fluoride varnish to their children when they were seen. Therefore, it appears that there is a need to educate families and providers regarding the benefits of fluoride supplementation for children, based on current scientific evidence and national recommendations.

Despite having adequate Medicaid insurance coverage that provides preventive and restorative dental services, many children from low socioeconomic families in Hawai'i continue to suffer from dental caries. Although socioeconomic status has been identified as a key social determinant of oral health, geographic location of residence can also impact dental access and outcomes. Families living in rural areas face several barriers when seeking dental care services for their children, including finding a dentist both able and willing to treat young children and willing to accept Medicaid reimbursement for dental services.²¹⁻²⁵ Additional barriers include limited transportation, lack of oral health education of families, and family cultural views that may not support the importance of preventive dental services, thereby delaying the utilization of dental care services until tooth discomfort exists.²⁶ The WIC program is an ideal environment that can provide easy access to oral health education for children and families, especially and women prior to, during and after pregnancy. It embraces the shared goals of promoting good nutrition and feeding practices in the early stages of a child's life that contribute to both the oral and overall health of WIC clients.

To assure the Kona WIC clinic staff about the efficiency in delivering oral health education during WIC visits, the pilot project intervention was timed and found to take approximately 12 minutes to complete the entire visit, with the majority of time spent obtaining informed consent and completing the questionnaire. The average time to actually provide oral health education to the parents/guardians was five minutes, with some additional time required when clients had questions about oral health/dental care issues (eg, "When will dental care be covered by Quest?"). Therefore, the short time required to complete the oral health/dental care education of WIC clinic clients during

this pilot project does not seem to be burdensome.

This pilot project's results were limited by the small sample size. In particular, the enrollment of only five pregnant women in the study did not allow for analysis about this population. Therefore, replicating the project at WIC sites with more pregnant clients than are enrolled at the Kona site could result in capturing important information about this vulnerable group. Additionally, a follow-up visit with pregnant women and/or parents/guardians who participated in the pilot project and completed the questionnaires and educational session was also not part of the project's approved plan. Therefore, there was no ability to assess the impact of the educational session on pregnant women's and/or parents'/guardians' changes in oral health beliefs and behaviors. Future projects such as this should include a follow-up assessment to determine the retention of knowledge, changes in oral hygiene behaviors, and how successful clients were at accessing dental services as a result of their oral health education through the WIC clinic.

Conclusion

The numerous effects of oral health disparities are far reaching for the children and families in Hawai'i. Dental disease and the discomfort often associated with the most advanced forms of the disease can affect a child's ability to eat and drink, speech development, and their ability to learn in the classroom environment.^{1,27,28} Many women of childbearing age also suffer daily with pain and decreased quality of life associated with dental caries and periodontal disease. In addition, these women may suffer the ultimate cost of periodontal disease with the potential for poor pregnancy outcomes including preterm labor, preterm birth, low birth weight infants, and neonatal complications.

This project's simple and feasible approach to educating clients already enrolled in the WIC program can be effective in reducing the costs of dental care because of the decrease in the need for restorative procedures associated with early childhood caries. This brief educational intervention can improve the quality of life for children and other family members by providing consistent messages by WIC clinic staff reinforcing healthy habits that can reduce the rates of dental decay in children as well as in other family members.

A successful and sustainable WIC clinic-based oral health education program can be built upon a strong, trusting relationship between the state and/or local health departments, WIC clinics, community dental and health care providers, community stakeholders and professional organizations. By offering oral health education in a WIC clinic and assisting clients to seek out comprehensive care within a dental home, children and their caregivers can be provided education and resources early enough in a child's life or a women's pregnancy to reduce poor oral health outcomes.

Conflict of Interest

None of the authors identify a conflict of interest.

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Are Rapid Influenza Antigen Tests Still Clinically Useful in Today's Molecular Diagnostics World?

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Abstract

Influenza virus infection and disease historically contribute to widespread cases of seasonal morbidity and in some cases mortality. Prompt and accurate diagnosis is crucial for optimal patient management. Rapid influenza direct antigen testing (RIDT) offers a faster turn-around-time for results but test performance (ie, sensitivity and specificity) varies widely. Nucleic acid amplification testing (NAAT) can offer a viable alternative. The objective of this retrospective study was to compare the test performance of RIDT with NAAT. RIDT testing included the Directigen EZ Flu A+B or the Veritor System for Rapid Detection of Flu A+B. NAAT employed the Simplexa™ Flu A/B & RSV assay. A total of 5,795 specimens collected from October to March for the 2012/2013 (n=953), 2013/2014 (n=2060) and 2014/2015 (n=2783) seasons were co-tested by RIDT and NAAT. Using NAAT as the gold standard, RIDT tests had a sensitivity range of 0 to 15.7% and a specificity of 98.2 to 100% for influenza type A. For influenza type B, RIDT tests had a sensitivity of 0 to 33.3% and a specificity of 98.9 to 100%. These findings suggest that RIDT has unacceptably low sensitivity for both influenza A and influenza B, despite high specificity. The key advantage of RIDT in previous years (faster turnaround time) has been challenged by newer NAAT technology that provides results in a turn-around-time comparable to RIDT, but with superior test performance.

Keywords

Influenza, rapid influenza direct antigen testing (RIDT), polymerase chain reaction (PCR), reverse transcriptase polymerase chain reaction (RT-PCR)

Abbreviations and Acronyms

*RIDT = Rapid Influenza Direct antigen Testing
RT-PCR = Reverse Transcriptase Polymerase Chain Reaction
PPV = Positive Predicted Value
NPV = Negative Predicted Value
NAAT = Nucleic Acid Amplification Test
LOD = Lowest Limit of Detection
PHI = Personal Health Information
HCP = Health Care Providers*

Introduction

It is estimated that 5 to 20% of the population will contract influenza during the fall through winter respiratory season each year in the United States.¹ The exception is Hawai'i, where influenza is present all year long with peaks also occurring during the respiratory season. Immunocompetent individuals recover from the flu without complications within about a week. However, more than 200,000 patients in the United States are also admitted to the hospital every year for flu-related complications, which are potentially life-threatening and sometimes fatal.²

The signs and symptoms of influenza disease are not specific to the influenza virus, because other respiratory viruses can present with a similar clinical syndrome. Therefore, rapid and accurate influenza detection is critical for the differential

diagnosis, infection control, appropriate antiviral treatment (if indicated), and control over unwarranted antibiotic usage.³

Influenza virus type A and type B are the common etiologic agents of influenza. Influenza viruses are RNA viruses and more prone to acquiring mutation than DNA viruses. As such, they are capable of antigenic shift and drift over time and the shift is defined by strain subtyping.⁴ This strain variability can impact vaccine efficacy, pathogenicity, variation in viral shedding, antiviral resistance, and could also have an influence on diagnostic test performance depending upon the methodology.⁴

Clinical diagnostic laboratory testing for influenza virus detection consists of conventional culture, rapid culture (shell vial), RIDT, and NAAT.⁵ Conventional and rapid cultures have been considered the "gold standard," but have been successfully challenged with the "platinum standard" of NAAT as a result of a superior test performance. This is evidenced by a high test positivity in a population with influenza (sensitivity) and a high test negativity in a population without influenza (specificity).⁶ Historically, RIDT has offered more rapid turn-around-times but has been shown to vary widely in test performance depending upon the methodology or even the influenza virus strain(s) in circulation.⁶ Newer NAAT platforms maintain the test performance of predecessor NAAT tests, but now have turn-around-times comparable to RIDT. This allows for "point of care testing" and shorter turn-around-time by providing more clinically actionable results.⁷⁻¹³

Studies in the literature have compared various RIDT formats and found a wide range of test performance, as summarized in Table 1.^{11, 14-26} However, none of these studies have focused on patient populations in Hawai'i. The current study addresses RIDT and NAAT test performance in this population by comparing test results over three consecutive respiratory seasons in Hawai'i.

Methods

Patients and Specimens

The patient population (ages less than 1 year to greater than 65 years) in this study included patients residing in or visiting the State of Hawai'i from whom specimens were collected and submitted for influenza testing during the 2012/13, 2013/14 and 2014/15 influenza seasons. Testing was performed at Diagnostic Laboratory Services (DLS, Aiea, HI, the reference lab for The Queen's Medical Center). Data was collected from the healthcare professional (HCP) that ordered both RIDT and NAAT (by reverse transcriptase polymerase chain reaction,

or RT-PCR) tests, or from the HCP that ordered RIDT testing with a negative result that was reflexed to RT-PCR. It should be noted that the request for reflex testing varied among the community-based healthcare providers. However, in compliance with the Queen's Medical Center's Infection Control Committee policy for hospitalized patients, all specimens with negative RIDT results were reflexed to NAAT testing for confirmation. Therefore, hospital-based testing resulted in a substantial number of specimens with both tests.

Specimens consisted mostly of nasopharyngeal swabs, but nasal aspirates or throat swab specimens were also included in some cases. All testing for the 2012 to the 2015 influenza seasons was performed at Diagnostic Laboratory Services, Inc. (Aiea, Hawai'i). Patient identifiers and other protected health information (PHI) with the exception of age and collection date were de-linked.

Laboratory Testing

Prior to February 8, 2013, the RIDT used by DLS was the Becton Dickinson Directigen EZ Flu A+B (Directigen; BD Diagnostics, Sparks, MD). This RIDT was replaced by the BD Veritor System for Rapid Detection of Flu A+B (Veritor; BD Diagnostics, Sparks, MD) beginning on February 8, 2013. Both RIDTs were used exactly according to the package insert instructions.

NAAT was performed using the Simplexa™ Flu A/B & RSV assay (Focus Diagnostics) with the 3M Integrated Cycler instrument. The Simplexa™ Flu A/B & RSV assay uses real-time RT-PCR amplification for the detection and differentiation of influenza type A, influenza type B, and respiratory syncytial virus (data on RSV was excluded from this study). RT-PCR testing consisted of two automated steps, RNA extraction and real-time nucleic acid amplification and detection.²⁷

Analysis

RIDT testing was compared NAAT, which served as the gold standard. RIDT results were classified as true positive (TP), if the specimen was positive for influenza A or influenza B by both RIDT and NAAT; true negative (TN), if the specimen was negative for influenza A and B by both RIDT and NAAT; false positive (FP), if the specimen was positive for influenza A or influenza B by RIDT, but negative for influenza viruses by NAAT; or false negative (FN), if the specimen was negative for influenza A or B by RIDT, but positive for either influenza virus by NAAT. Sensitivity was calculated using the formula $TP/(TP+FN)$, and specificity was calculated as $TN/(TN+FP)$.

Results

RIDT performance was benchmarked using the NAAT as the gold standard for the 2012/13, 2013/14 and 2014/15 respiratory virus seasons. A total of 5,796 specimens were co-tested with 953 tested in the October to March 2012/13, 2060 specimens in the 2013/14, and 2783 specimens in the 2014/2015 respiratory seasons. Circulating influenza type A virus strains present during this time period consisted almost exclusively of the seasonal

influenza type A H3N2 with a rare appearance of the influenza type A 2009 H1N1, which was mostly reported in late 2012 and early 2013.²⁸ The percentage of specimens positive for influenza virus type A virus peaked at 32.0% in February 2013, 22.2% in January 2014, and 31.1% in January 2015. Likewise, the percentage of specimens positive for influenza virus type B peaked in the month of May at 21.1%, 8.3%, and 11.0% in 2013, 2014 and 2015, respectively.

Based on the NAAT result serving as the gold standard, the RIDT revealed a monthly sensitivity and specificity range of 0-15.7% and 98.2-100% respectively for influenza virus type A, and 0-33.3% and 98.9-100% for influenza virus type B respectively, as shown in Table 2. The negative and positive predictive values ranged from 80.9-99.5% (NPV) and 84.2-100.0% (PPV) for influenza virus type A virus detection, and from 95.5-100% (NPV) and 0-100% (PPV) for influenza type B virus detection respectively (data not shown). The highest discordance between RIDT and NAAT results for influenza virus type A was seen in January 2015. It should be noted that this observation coincidentally occurred during the month with the highest number of influenza positive tests seen over the entire study period.

Discussion

From 1976 to 2006, influenza accounted for up to 49,000 deaths annually in the United States.^{29,30} Influenza virus infection may be more severe when accompanied by related coinfections and complications. It is also associated with an increase in hospitalizations of the very young, elderly, and those with other risk factors; increased hospitalizations are especially prominent during epidemics.³⁰ A timely and accurate diagnosis is critical for optimal patient care for several reasons: first, it enables the proper and timely use of appropriate antivirals. Second, it avoids the use of unwarranted antibiotics, which in turn may mitigate the global rise in antimicrobial resistance.³¹

Conventional cell culture, rapid culture (shell vial), RIDT, and NAAT have all been used for diagnostic support of influenza virus infection. While conventional cell culture is typically considered the "gold standard," its clinical utility is limited because the test requires up to 5 to 7 days; shell vial culture is another technique with excellent performance, but despite offering a vast improvement in timeliness compared to conventional cell culture, requires 24 to 48 hours for completion.⁵ These turnaround times may compromise the HCP's ability to provide antiviral treatment within the optimal window of 48 hours upon illness onset.³² NAAT offers the best test performance with a shorter turnaround time (18 minutes to 3 hours), but at a higher cost. Given the high sensitivity and specificity of NAAT, it was used as the gold standard in the current study. The current study demonstrates that while RIDT has a faster turnaround time, it demonstrates unacceptably low sensitivity for both Influenza A and influenza B viruses compared to NAAT (as shown in Tables 1 and 2).²⁶

RIDT tests in the present study were substantially less sensitive, with a higher number of false negative results. This finding

Table 1. Literature search showing the median, mean and range sensitivity and specificity for influenza virus type A (n = 28) and type B (n = 7) test performance using Rapid Influenza Diagnostic Tests.

Statistical Value	Influenza A		Influenza B	
	Sensitivity	Specificity	Sensitivity	Specificity
Median	63.5	99.0	78.6	98.7
Mean	59.1	98.3	73.3	97.3
Range	9.7 - 95.8	91.1 - 100	40 - 92.9	89.7 - 100

Table 2. Rapid Influenza Diagnostic Test (RIDT) influenza type A and type B test performance range compared to Nucleic Acid Amplification Tests (NAAT) as the reference (gold standard) for the influenza seasons 2012-2013, 2013-2014, and 2014-2015.

Year	Influenza A		Influenza B	
	Sensitivity	Specificity	Sensitivity	Specificity
2012	0	100	0	100
2013	0 – 6.7	98.2 - 100	0 – 33.3	98.9 - 100
2014	0 – 14.3	100	0	100
2015	9.8 – 15.7	99.5 - 100	0 – 21.4	100

was even observed during the peak of respiratory season when influenza incidence was the highest. The first RIDT used was the BD Directigen EZ Flu A+B nasopharyngeal assay, which has a fifteen minute turnaround time to results. According to the package insert, this test should exhibit a sensitivity of 91%, a specificity of 93%, a PPV of 88%, and a NPV of 94.8% for Influenza type A virus. Likewise, the second and more extensively used RIDT assay was the BD Veritor System, which has a turnaround time of ten minutes, and according to the package insert should exhibit a sensitivity of 78.8%, a specificity of 97.8%, a PPV of 93.8%, and a NPV of 91.4% for influenza type A virus. However, the medical literature indicates that RIDT often exhibits a wide range of test performance (i.e. especially for test sensitivity) and is consistently unpredictable across different assays (Table 1). Based on the literature, sensitivity ranges from 9.7-95.8% for influenza type A and 40-92.9% for influenza type B (Table 1). One of the RIDT tests used in the present study (BD Veritor System) was challenged in a Centers for Disease Control and Prevention study against six other RIDT for the detection of influenza type A H3N2 virus.³³ The BD Veritor and the Sofia revealed the lowest limit of detection among the seven RIDT evaluated.³³

There are many variables to consider in accounting for differences in test performance, such as the type of assay, the circulating viral subtype and even the course of disease and viral shedding pattern for the particular circulating influenza virus subtype.⁶ Another factor to consider is the high variability in performance of RIDTs when evaluating emerging strains of influenza viruses.³³ In a study by Yang, et al., the test perfor-

mance of RIDTs in detecting emerging influenza A subtypes demonstrated a lower sensitivity for a newly emerging strain, the pandemic Influenza A (H1N1 subtype at 55.8%) compared to a seasonal strain that had been in circulation (Influenza A, H3N2 subtype) at 71.0%.³⁴ These differences were further modified by the underlying demographics. The performance of the BD Veritor was found not only to be affected by the circulating viruses, but also by patient age, which was inversely related to the test's sensitivity. The BD Veritor system's sensitivity for children less than 2 years of age was 85.7%, compared to 60.3% for children and adults between 2 and 39 years, and 33.3% for adults aged ≥ 40 years.²⁰ This may be due to the fact that there is an inversely proportional relationship between the amount of virus shedding and the age of the patient.²⁰

The variations in sensitivity is dependent upon a variety of factors that cannot be controlled and suggests that in order for the test findings of RIDTs to reliably guide treatment, there is a need for more RIDT quality assurance. In other words, each RIDT should be accessed for the ability to detect multiple virus subtypes on a continual basis. This would be a challenging task. However, such a testing recommendation has been proposed by the FDA. Typically, if an assay is cleared by the Food and Drug Administration (FDA), manufacturers are not required to conduct regular quality assurance and reevaluation on the assay. However, due to the poor test performance of RIDT flu testing, the FDA proposed regulation §866.3328 of the Code of Federal Regulations (CFR), which specifies the need for a mandatory annual analytical reactivity testing of contemporary influenza strains for all RIDT tests.³⁵ This CFR also includes testing for emerging subtypes that pose a danger to public health.³⁶

By contrast, NAAT has the distinct advantage of consistently exhibiting the highest sensitivity and specificity. It is noteworthy that NAAT also exhibits a high test performance even when emerging influenza virus strains are encountered; NAAT has been shown to be more consistent and to excel in test performance compared to RIDT.⁶ In fact, RIDT test performance has been so variable over the past seasons that the Queen's Medical Center Infection Control Committee has incorporated an algorithm that required a reflex for all negative RIDT to the more sensitive and specific RT-PCR. Hence, RIDT testing may even be clinically and financially wasteful, as it may often be followed by NAAT support as follow-up testing, which is more expensive and extends the turn-around-time on test reporting.

In the current study, RIDT test performance revealed the highest number of false negative results near the influenza peak of the respiratory seasons. This was unexpected, because the highest test performance is expected to occur during the time of peak influenza incidence.³⁷ Furthermore, this observation has clinical relevance, since it is most critical to optimize patient care during the peak of flu season. This peak period is when most influenza-related hospitalizations may occur and antiviral therapy may be most needed to reduce transmission. The potential risks of using a less accurate test such as RIDT are delayed diagnosis, increased transmission, and potential hospitalization with the chance of serious complications, in-

cluding death.^{29,30} Ironically, RIDT sensitivity is lowest among the elderly, which is the population at greatest risk for serious negative outcomes.

Patient age was not formally evaluated in the present study, but the expected relationship between age and sensitivity was anecdotally confirmed in the present study. The lowest percentages of false negative results was observed in patients less than one year of age, while the older patient age groups had an incremental proportion of false negative results (data not shown).

Finally, another noteworthy anecdotal observation was a change in HCP behavior reflected in the type of influenza testing ordered. Over the course of the three seasons under study, the influenza tests ordered by HCP's revealed a steady increasing trend in requests for NAAT testing and a corresponding decrease in orders for RIDT testing. This observation may very well reflect the lack of HCP confidence in the RIDT test performance compared to NAAT, although this hypothesis was not formally evaluated.

In summary, a current challenge for the field of molecular diagnostics is to simplify the testing and reduce turnaround times while maintaining optimal test performance. For influenza testing, a viable solution has finally been realized with the recent introduction of the FDA cleared and in some cases CLIA waived latest generation of NAAT tests. This includes the cobas[®] Liat System (Roche Diagnostics), the Alere i Influenza System (Alere), and the Xpert[®] Xpress Flu/RSV (Cepheid).^{10,38,39} The Alere i Influenza System employs isothermal NAAT testing to provide ultra-rapid nucleic acid amplification to detect and distinguish between influenza virus type A and B in approximately 10 minutes.¹⁰ The cobas[®] Liat technology consists of a simplified, automated RT-PCR assay exhibiting high test performance, which also has the advantage of a greatly reduced testing time period compared to conventional NAAT.³⁸ The cobas[®] Liat System is a rapid *in vitro* qualitative NAAT that discriminates between influenza virus type A and B and generates a result in about 18 minutes.³⁸ The specimen (i.e. nasopharyngeal swab) undergoes nucleic acid extraction and amplification/detection using RT-PCR. This assay requires no additional reagent preparation aside from the addition of the specimen to the Liat tube. In addition, there is virtually no cross-contamination between samples because each Liat Tube is self-contained.³⁸ The cobas[®] Liat package insert claims a 100% sensitivity, 97.1% specificity, 96.1% PPV, and 100% NPV.³⁸ Any one of the newly introduced, "near patient diagnostic testing" NAAT is comparable to RIDT in turnaround time. However, they all have the added advantage of high test performance similar to the "classic" RT-PCR molecular test formats.

The current study has some limitations. First, because of the use of de-identified data, other variables that may have influenced the outcome of the study may not have been considered in the analysis. Second, the study group was a patient population residing in the state of Hawai'i, and may not be equivalent

to other patient populations, which may exhibit a difference in test performance. Likewise, these results may also reflect circulating influenza subtypes in Hawai'i that may be different from those circulating in other geographic locations. Lastly, the data gathered in Hawai'i came from a single testing laboratory, Diagnostic Laboratory Services. Therefore, the findings may not be representative of the entire patient resident population in the State of Hawai'i.

Despite these limitations, other investigators have reported similar results showing that many RIDTs are not reliable. The current study confirms the findings from other investigators in support of the unreliability of RIDTs for the patient population in the state of Hawai'i. This report allows our medical community to better understand the usefulness of ordering a diagnostic test with the highest test performance and the tradeoff advantage between increased test cost and patient outcome. It is important to educate HCPs on the RIDT test performance variability and the advantage of using a more reliable, but more expensive NAAT test in order to consistently achieve more favorable patient outcomes. Based upon the findings in the present study and our literature review confirming these findings, the recommendation to HCP's is to order NAAT in place of RIDT. In consideration of the emergence of new generation NAAT technologies with higher test performance and test turn-around-time comparable to RIDT, the higher cost of the NAAT may be outweighed by the benefits of reliability, accuracy, and comparable timeliness.

Conclusion

The current report describes the advantages and disadvantages of two of the most common influenza tests, RIDT and NAAT. In this study, NAAT was chosen as the gold standard. RIDT revealed an overall very weak test performance, even during the peak of the influenza seasons where the test performance should have been the highest. These findings are confirmed by multiple studies reported elsewhere, and demonstrate the low RIDT reliability to be a significant concern for influenza detection and management in Hawai'i. The newly introduced NAAT methodology has improved turn-around-time while maintaining high test performance. Examples include such tests such as the cobas[®] LIAT system, Alere i Influenza System and the Xpert[®] Xpress Flu/RSV. Anyone of these tests have satisfied the need for faster turnaround times that are comparable to RIDT, while consistently maintaining optimal test performance. These newly introduced, "near patient diagnostic testing" NAAT show great promise in now offering a viable replacement to RIDT. Similar to other investigators, the results presented in this study have provided further evidence that RIDT is not reliable in the Hawai'i patient population and it may be time to consider replacing RIDT with the newly introduced rapid "near patient diagnostic testing" NAAT. HCP's are strongly urged to request NAAT for influenza testing in place of RIDT to avoid delayed or missed diagnoses of influenza.

Conflict of Interest

None of the authors identify a conflict of interest.

Author Disclosures

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MEDICAL SCHOOL HOTLINE

The Many Ways Physicians Care for Patients

Karen Thompson MD

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

Honored Guests, Faculty Members, Alumni, Family, Friends, and of course, Students of the John A. Burns School of Medicine, or JABSOM Class of 2022—a heartfelt congratulations to all of you on your acceptance to JABSOM!

I am deeply honored to be speaking to you this evening, and deeply honored to be the 2018 Leonard Tow Humanism in Medicine Awardee. And as a pathologist, I am especially honored and pleased because we pathologists are not particularly known for our bedside manner; or for interactions with patients at all, for that matter. In fact, there are a number of long-held stereotypes about pathologists that aren't particularly flattering—that we are socially awkward “Sheldon Cooper” types, and that we just hole ourselves up in our offices every day and look under the microscope. But I believe these stereotypes to be outdated and untrue—well, except for the fact that we do really love looking at stuff under the microscope. Also, most of my pathologist colleagues do have direct contact with patients—and to clarify, I am referring to living patients. But what this honor means to me, and what I hope to highlight to you incoming first-year medical students in this speech, is that there are many ways to express your care and compassion for patients: through your direct communication with them, and through a variety of other direct and indirect ways; and you student doctors will be involved in every one of them during your training at JABSOM and beyond.

First of all, what is humanism, in the traditional sense? Dr. Carol Cho of the University of Pennsylvania wrote a piece for the Gold Humanism Honor Society Newsroom¹ that lists the habits of highly humanistic physicians and describes a humanistic approach to patients as one that is sensitive to cultural backgrounds, values, and preferences of the patient. In attitude, they: “approach patients with humility and real curiosity about their lives, especially toward those patients whom it may seem difficult to relate.” They “treat their patients as they themselves would want to be treated,” and “see their role as not merely taking care of the medical aspect of their patients but also helping their patients through life struggles.” She states that habits of humanistic physicians include “ongoing and active self-reflection.” JABSOM students are known for these traits, and thus, I have no doubt that all of you on this stage will be compassionate toward your patients and good listeners to their medical as well as non-medical concerns.

There are many indirect ways that healers compassionately care for patients. I will begin by highlighting those who work behind the scenes. Pathologists, for example (I couldn't help mentioning my own specialty) although we usually do not meet the patients who we care for, are acutely aware that every blood sample, gastrointestinal biopsy, and surgical resection specimen that we analyze represents a patient, and that whatever diagnosis we render can and will impact that patient's life in significant and often permanent ways. Communication with our clinician colleagues regarding the patient's clinical picture is essential to a pathologist in arriving at an accurate and meaningful diagnosis, and in suggesting the appropriate tests to order. So students, please seek us out so that we can help care for your patients together. Pathologists are easy to find: we are typically located in the hospital basement. Another example of healers who work behind the scenes is our dedicated medical research faculty colleagues whose compassionate and meticulous life's work results in the exciting discoveries that form the basis of our diagnostic and treatment abilities.

A second indirect way that physicians compassionately care for patients is through leadership. Physicians are leaders who support and steer their medical teams. Humanism toward your teammates, colleagues, other medical professionals, and hospital staff ensure that they will remain enthused, motivated, and equipped to do their job well in a positive environment. This translates to excellent patient care. All of you students will experience leadership responsibilities at all levels throughout your careers as students, residents, and attending physicians. Observe and learn from the leaders around you which traits you wish to emulate, and which you don't as you rise through the leadership ranks and inspire your own teams.

Thirdly, the education of future physicians – both teaching and administering medical education – although technically an indirect means to compassionately care for patients, seems to me to be a direct one. Everyone from the Office of Medical Education, Office of Student Affairs, the Dean's Office, as well as tutors, clinical preceptors, and facilitators show their care for patients by ensuring that you are superbly educated and trained in all aspects of medicine: biological, clinical, as well as in professionalism. So students, since it equates to superb patient care, your medical training will necessarily be very rigorous. Know that you will not embark upon this journey

alone, because of the last way that I will highlight to indirectly show compassion toward patients; through mentorship.

I greatly respect those who seek the wisdom of mentors. So much so, that as an interviewer of JABSOM medical school applicants, a question that I would always ask the applicants was, “tell me about a mentor of yours, and how this person impacted your life.” In most cases, the applicant would light up and tell me about a parent or other relative, a teacher, a coach, a research mentor, or family physician. Several applicants were overwhelmed by the number of mentors in their life, and didn’t know where to begin in selecting one to highlight. I was pleased with all of these responses; because what it told me about these applicants was that they respected the wisdom of others, that they were eager to learn, and that they recognized that they needed guidance and advice from someone more experienced. In my opinion, this type of self-awareness is critical in the ability to provide excellent care to patients. So, Students of the Class of 2022, seek out mentors here at JABSOM. There are numerous excellent candidates right here in this room and seated next to me, wearing white coats. Medicine is a family, and like a family member, the mentors you choose will stand by you and support you throughout your careers, just like my wonderful mentors in medicine continue to do for me. And over the years I have come to realize that the best gift a student can give to a mentor is to become a mentor themselves.

In the daunting journey that lies ahead of you students in your quest to become healers in whatever direct or indirect ways you choose to heal, there will be many times of great joy and excitement, and there will also be many challenges. Know that you will not be traveling this road alone; because in addition to the support that your family and friends and fellow students will provide for you, your future JABSOM mentors, leaders, and teachers, many of whom are in this room tonight, will be there for you every step of the way—both during and beyond medical school. Congratulations and welcome to the JABSOM *O’hana*.

Dr. Karen Thompson is a professor and chair of the Department of Pathology at the University of Hawai’i John A. Burns School of Medicine. This presentation was given upon her receipt of the 2018 Leonard Tow Humanism in Medicine Award, of the Arnold P. Gold Foundation, White Coat Ceremony, Honolulu, Hawai’i, 20 July 2018.

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INSIGHTS IN PUBLIC HEALTH

An Island-Wide Community Food Assessment in Lana‘i, Hawai‘i: A High School Student-Centered Project

Karen de Brum and the Lana‘i High School Expository Writing/STEM students*

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

Abstract

Lana‘i is a geographically isolated Hawaiian island of approximately 3,100 residents. During the 2017-2018 school year, 22 Lana‘i High and Elementary School juniors and seniors engaged with community members, kupuna (elders, those who stand at the source), stakeholders, and expert consultants to conduct an island-wide Community Food Assessment (CFA). A CFA can provide a community comprehensive information about their food systems. Particular attention was given to indigenous, Native Hawaiian food culture and needs. Students collected 656 surveys from a population of about 2,200 adults. Students also completed 14 separate focus groups, interviewing a total of 43 adults in the Lana‘i community. This high school student-driven project was the product of many years of engagement and preparation, generosity from community members and content experts, and fortunate circumstances. This paper (1) describes the history of the project, providing useful details around the process of building capacity, leveraging connections, and engaging high school students and community members around a critical health issue in this rural community; and (2) highlights key findings that will be useful for policy development and advocacy.

Background

Lana‘i is a geographically isolated Hawaiian island located approximately 8.5 miles from Maui. The island is home to approximately 3,100 people who all live in the small town of Lana‘i City.¹ Ninety-eight percent of Lana‘i island is privately owned and has been since the late 1800s. The bulk of Lana‘i’s employment and economic opportunity is controlled by the landowner’s company, Pulama Lana‘i, and the Four Seasons, which manages the luxury hotel on the island.¹ Over 19% of Lana‘i is full or part Native Hawaiian.²

Ancient history tells that Lana‘i’s food resources once supported at least 6,000 residents.³ In the more recent past, Lana‘i’s food resources supported all the striking pineapple plantation workers and their families for 200 straight days during the 1951 pineapple strike.³ Today, however, Lana‘i, like most of the state of Hawai‘i, imports almost all of its food from off-island sources.⁴

We know from the Behavioral Risk Factor Surveillance System (BRFSS) that 66.2% of Lana‘i residents report being either obese or overweight. This is the highest of any island in the state.⁵ At 33.9%, Lana‘i also reports the highest high blood pressure prevalence of any island in the state.⁵

Project

During the 2017-2018 school year, 22 Lana‘i High and Elementary School (LHES) juniors and seniors engaged with community members, kupuna (elders, those who stand at the source), stakeholders, and expert consultants to conduct an island-wide Community Food Assessment (CFA). A CFA is a tool used to gather comprehensive information about community food systems.

The primary goal of the CFA was to understand how the Lana‘i community thinks about and accesses food and to learn about connections between food, diet and culture on Lana‘i. Particular attention was given to indigenous, Native Hawaiian food culture and needs. Students collected 656 surveys from a population of about 2,200 Lana‘i adults. Students also moderated 14 separate focus groups, interviewing a total of 43 adults in the Lana‘i community.

This high school student-driven project was the product of many years of engagement and preparation, generosity from community members and content experts, and a number of fortunate circumstances. This paper (1) describes the history of the project, providing useful details about the process of building capacity, leveraging connections, and engaging high school students and community members around a critical health issue in this rural community; and (2) highlights key findings that will be useful for policy development and advocacy.

History

The seeds of this project began in the 2015-2016 school year when, as part of their general curriculum, LHES high school students studied food production, consumption, and distribution on Lana‘i. This introduction generated interest in focusing more student research on the food system.

Fortunately, LHES had contracted with The Creative Core, an educational organization which aims to transform schools into fully engaged hubs of school-community integrated project-based learning. Ms. Karen de Brum (the high school English teacher) was in a cohort of teachers developing place-based, project-based learning (PB)² curriculum. In the next academic

year, as part of (PB)² in English class, LHES sophomores worked on projects around food with a driving question of: *How does what we eat affect who we are, how we feel, and what we hope to become?* This became the driving question of the whole enterprise to understand the food system of Lana‘i.

Given the students' interest, it was fortunate that Ms. de Brum then met A-dae Romero-Briones, a food law expert and lawyer who explained the purpose and methods of a CFA. Ms. Romero-Briones agreed to work with a group of six students to conduct a pilot CFA during the 2015-2016 academic year. These students collected about 200 brief surveys primarily from fellow high school and middle school students. The results showed strong interest in this topic, but more insights were needed since the people taking the survey were not making the decisions about what to buy/eat nor were they the primary source of family incomes. In particular, there was interest in gaining more detail about the community's relationship to the food system from the perspective of adults in the community.

In the 2016-2017 school year, the (PB)² program continued. The high-school English students and Ms. de Brum remained committed to more food projects, many of them centered on breadfruit and the lack of other, culturally appropriate food on Lana‘i. A specific group of six students chose to complete a second, more comprehensive CFA. They connected with Lisa Grove, of Anzalone, Liszt, Grove Research, to refine the survey tool. With help from Ms. Grove, they spent the year researching and developing a survey tool that would attempt to draw out the community's relationship to the food system. They also continued their relationship with Romero-Briones to get advice and suggestions using her deep experience with CFAs in other communities.

In order to engage the community and perform data collection and analysis, funds were needed to support technology, purchase incentives, and compensate consultants who could support and advise the work. Ms. de Brum actively began searching for grants and Romero-Briones connected them to Laulima Kuha‘o, a Lana‘i non-profit started at the time of the island's economic shift from agriculture (pineapple) to tourism.

Laulima Kuha‘o's board is 75% Native Hawaiian and made up of agriculture enthusiasts passionate about strengthening Lanai's food system, connecting people with the land, celebrating the past while securing Lanai's future in food production, all while growing the next generation of farmers. They were an excellent partner for the CFA. Through The Conservation Fund and First Nations, with funding from the Kellogg's Foundation, Laulima Kūha‘o was given \$25K to conduct an island-wide, community food assessment, done entirely by high school students.

The students piloted their survey tool in May 2017 with LHES faculty and at an annual Showcase event for the (PB)² program. The survey tool focused on four areas: food and access, food and identity, food and economy, food and health. It consisted of an online version using Google Forms and paper copies for those who prefer paper and pen. From the pilot, the students revised the tool, adjusted some of the questions, and were ready



CFA student helps his kupuna complete a survey for the CFA

for a full-scale survey of the island community. Community merchants provided discount gift certificates of \$2.50 to use as incentives for people who were willing to take the survey. A number of canvas shopping bags, imprinted with the Laulima Kuha‘o logo and the CFA driving question (*How does what we eat affect who we are, how we feel, and what we hope to become?*) were also available for participant incentives. The goal was 1,000 surveys of full-time, Lana‘i residents, ages 18 and over, and to moderate focus groups to specifically capture the voice of their elders and *kupuna* about food, culture, and health.

Methods

The students knew their community and created their own sampling frame, deciding that the survey should be taken out of the school and into the community spaces where residents were already gathering. Interviews, which took approximately 15 minutes, could be taken on laptops or tablets through Google Forms, or by paper and pencil. Interviews were conducted at various events (eg, Queen Liliu‘okalani's Birthday Celebration in Dole Park), various local parks and shops (eg, Coffee Works and Dole Park), and community residential and business locations (eg, Lana‘i Senior Center, First Hawaiian Bank and the Bank of Hawai‘i). Surveys were analyzed by the students using Excel.

Focus groups were also conducted. After extensively pilot testing the discussion guide and practicing focus group moderation with experts, between November and December, 11 students moderated 14 separate focus groups of adults in the Lana‘i community. These groups considered gender, age range, and culture in order to make sure everyone would feel completely comfortable answering questions openly and honestly. Each focus group participant received a culturally appropriate meal, a canvas CFA bag, a gift certificate to a local market, and a small gift card. Data from the focus groups were transcribed.



CFA students host a focus group.

Qualitative data were analyzed using the transcripts and color coding participants' language into themes and sub-themes using Microsoft Word and Microsoft PowerPoint.

The project was conducted in concordance with Department of Education policies and relevant ethical guidelines for research conducted by high school students.⁶ Information was recorded by the students in such a manner that respondents could not be identified, directly or through identifiers.

This article provides an overview of key findings. More detailed information about study results are available upon request from the authors.

Results

Overall, results from both the surveys and focus groups strongly supported each other. Results described that while people love Lana'i and take fierce pride in its uniqueness and self-reliance, there is concern about the direction the food system has taken since the closing of the pineapple plantation.

Food and Economy

Most Lana'i residents have to go off island to get the food they need, spending hundreds of dollars per household each month on off-island purchases. Produce, meat and other non-perishable items are on their off-island grocery lists, along with healthier and organic as well as cultural foods.

A lot of money is spent on produce not grown on Lana'i that is either purchased off-island or in local stores. The amount residents spent on imported produce far exceeds what they spend on locally grown produce. There is a lost opportunity when it comes to providing island produce, not to mention the time spent off-island just to meet basic needs. While many residents shop both on and off-island, people who do shop off-island do so because of the lower prices and the wider variety, not because the food on Maui or O'ahu is healthier.

Food and Access

The high cost of healthy, culturally appropriate foods was a common concern. People would very much like to see more cultural staples like *'ulu* (breadfruit) and *kalo* (taro) grown and available on Lana'i. Respondents shared a desire to eat more, fresh, island-grown produce but said they can not because it is not affordable. High produce prices in particular make it hard to eat healthy. There was strong interest in small, family gardening, being able to grow their own food, and supporting small farmers who grow food for sale in the community, but obstacles like access to land and lack of time mean that many people rely on imported foods because it is all that is available.

Despite feeling concern for the affordability and availability of fresh, healthy, foods on Lana'i, participants were pleased that the stores have improved over time. Some spoke about the increased access to foods that support dietary restrictions, like gluten-free options, and some also mentioned the growing availability of some organic foods.

Surveys and interviews alike also acknowledge that this increased variety is not accessible to all residents. Food variety was seen as an option only available for rich people. The community wanted more food that is affordable for everyone in their stores.

Food and Health

One conclusion is that the struggle to afford and access the kinds of foods Lana'i families wish they were eating is having a detrimental effect on the health of the community. While large numbers of respondents say that they or household members do not yet have health issues, the majority who did report health issues said they were often told that their issues are connected to diet. The older focus group participants acknowledged that, while their health issues started later in life, they believe that their children's eating habits now will similarly have a negative

impact on their health, but they do not know how to change that when the kids do not see or feel the problem themselves.

Food and Identity

Many participants describe the differences between plantation days, when many families had small gardens where they grew their own fruits and vegetables, and now. This shift from eating locally grown produce creates concerns about the loss of culture in the children and on the island. Because so many families have little choice but to eat an acculturated diet, many parents and elders express dismay at the cultural degradation that results from the shift from traditional, cultural foods to a more western and often processed or pre-packaged diet. Many residents stated that the convenience and accessibility of processed and prepared foods is a large reason that they rely on these for themselves and their families.

Some other reasons local families said their diets were changing include the cost of fresh, healthy food, family schedules with night shifts and split shifts making it hard to enjoy family meals, and a lack of access to culturally appropriate foods such as breadfruit and taro. At the same time that families struggle to access and prepare these cultural foods, their kids are becoming more and more enamored of prepared, pre-packaged food that most recognize as unhealthy but convenient. Participants often expressed that they were not sure what they can do to turn this around.

Though respondents say that there is not enough sustainably, locally (Lana'i) grown fruits and vegetables that are affordable, focus group participants and survey takers all describe an active and enthusiastic number of people who hunt for meat and fish. Many who do not hunt or fish themselves take advantage of meat and fish that friends and family bring home and share or sell. This culture of providing protein for themselves is a clear source of pride and identity on the island. Fishing and hunting is an important part of the community. It is more than a quest for food, sustainability and survival; it is part of the island's cultural identity. Respondents say hunting and fishing are a

“part of the lifestyle” on Lana'i and producing food locally is a point of pride.

Lana'i residents feel very strongly that food connects them to their culture. Most eat cultural foods at least once a week and it is purchased locally, rather than grown or purchased off island. Foods like 'ulu/breadfruit, *kalofafal* taro and yams top the list of eaten items. However, as previously noted, they do not believe there is enough affordable, culturally appropriate produce for purchase or that it is too expensive. Breadfruit was the most desired cultural staple. It was so prevalent that a word search showed that it was mentioned 40 times by focus group discussants. Discussants were also passionate about *kalofafal* taro and considered it an under-tapped resource on island. Fresh poi was also requested on a more regular basis. It was clear having a broader cultural conversation, possibly including prepared cultural foods, is needed.

Dissemination of Results

The students presented their findings to the community at large on May 15, 2018. About 37 community members came to see the presentation. There was high interest in the data from the community. Most follow-up questions after the presentation were, “What's next?” A few community members left comment cards; all the comments were positive. One audience member signed the card, “A proud Lana'i resident.” The students really appreciated the fact that someone was “proud” of their work.

This paper highlights not just the important finding of the CFA itself, but also the enthusiasm, hard work and positive outcomes from the student engagement. Students were met with enthusiastic support as they completed the surveys. They became noticeably more confident, clear and sophisticated in their ability to communicate the goals of the project and how individual participation in the survey would benefit the community. The students also presented to Pulama Lana'i stakeholders and supporters from the Liliu'okalani Trust on May 22, 2018 and the Lana'i Community Health Center (May 23, 2018).



The CFA team of students. How does what we eat affect who we are, how we feel, and what we hope to become?

Project-Based Learning

This CFA was not only about collecting, analyzing, and presenting the research; it was also about *teaching the students how to collect, analyze, and present* the data. This is how students demonstrated mastery of their English Language Arts standards. Of the 22 students who completed this project, only three had any prior knowledge of a CFA, and only two of those three knew anything about the survey tool that was created during school year 2016-2017.

Project-based learning requires scaffolding, which means relying on many supports early on in the project and slowly but surely scaling those back as the project goes on so that as the students become more proficient, they are also becoming more and more self-reliant. In the beginning, students read a lot of articles, local, national, and international, on global food issues. They discussed global and local concerns about food access and food sustainability, and wrote reflections about the different texts. This kind of reading about larger food issues got them ready to analyze the Lana'i data; they could better understand the community's results, reactions and discussions because they had a broader context of food issues in other places.

Similarly with writing, students began writing reflections of their readings and their process throughout the data collection stage. Since there was not a lot of analysis to do until all the data was in, they focused their writing more on the ways their own thinking and learning was being impacted by their engagement with the community, their work with each other, and the food assessment process.

Conclusions

The authors hope the study results can be used by Lana'i people to create an action plan around food for the island, give a voice to the community's relationship to the food system, and create a space to foster discussions about our *kuleana* (right, responsibility) to feed the Lana'i community.

For detailed study results please contact Ms. Karen de Brum at kdebrum@lanaischool.k12.hi.us.

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**Lana'i High School Expository Writing/STEM students: Ashley Agcaoili, Gina Anton, Naighel Calderon, Emma de Brum, Jomel Etrata, Nichole Galdones, David Hughes, Steven Jackson, Morgan Jonas, Liana Koanui, Nalu Lopez-Agliam, Kamele Mano-Nakooka, Micah Manuel, Tabitha Medeiros, Alex Natividad, Joel Nisperos, Roderick Noble, Geo Pillejera, Hailey Spano-Calderon, Alika Tan, Christian Teppang, JP Thompson*

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THE WEATHERVANE

RUSSELL T. STODD MD; CONTRIBUTING EDITOR

THE TIMES THEY ARE A CHANGIN'.

An American institution dating back almost 100 years, the Miss America pageant, is going by the boards. The competition began in 1921 as a swimsuit contest when it was considered modern and liberating for women to pose in bathing suits. Now, Gretchen Carlson, a former Miss America, is the chairwoman and has dropped the swimsuit and evening-gown competitions. They will be replaced by ever-thrilling extended on stage interviews. Ms. Carlson believes it is important to make women's voices heard in the "cultural revolution in our country." The TV broadcast is of critical importance to the program as it generates a large piece of revenue. When asked for comments, Ms. Carlson said no binary choice between swimsuit and television deal was ever posed. The organization has long been on precarious financial grounds with a net loss of \$575,000 in 2016 on revenue of \$9.8 million. The immediate result of this to-do is that almost half of the board has quit or been asked to resign.

FIFI, YOU AND PHIDEAUX ARE GOING TO MISS THE NEXT TRIP.

Airlines have had it trying to provide emotional support animals. Barely a week passes without a story of a pet trapped under a folding seat or in an overhead compartment. Current guidelines force carriers to accommodate a menagerie of critters that are often poorly behaved. They defecate and urinate in the aisles and have bitten, licked, jumped on and growled at other passengers. Carriers complain that passengers are taking advantage of the US Department of Transportation broad definition of a service animal. Air carriers are urging regulators to change the parameters for flying with service animals. It is past time to draw a distinction between trained service dogs that assist people with psychiatric or physical disorders, and animals that provide more passive emotional support. The USDT has agreed to revisit their rules.

AH, THE ENVIRONMENTALISTS. THEY KILLED MILLIONS BY SPREADING MALARIA WITH A BAN ON DDT, BUT FAILED TO BAN GMOS.

The people, many of them scientists, who attacked GMOS now have a steady diet of eating their words. Talk show host Jimmy Kimmel sent a reporter to a west coast farmers market in 2014 asking shoppers what they thought of GMOs. All customers stated their horrified avoidance of GMOs, but none could explain what GMO stood for. The letters mean genetically modified organism. The opposition was largely inspired and led by environmentalists calling for food boycotts of "frankenfoods." They claimed that GMOs would damage the environment because they were bred to withstand weed killers and would be used to excess. They asserted that GMOs were bad for the developing world, tying farmers to expensive new seeds that would not reproduce. Perhaps most crucially many opponents claimed that GMO foods were a threat to human health, causing a higher incidence of everything from cancer and autism to diabetes and obesity. Contrary to initial fears, the overall impact of genetically modified crops has been to dramatically reduce the amount and toxicity of pesticides sprayed by farmers. 90% of Indian cotton acreage now consists of insect resistant GMO plants, 37% less chemical pesticide is used for GMO crops than for conventional versions. The American Association for the Advancement of Science declared, "The science is quite clear: Crop improvement by the modern techniques of biotechnology is safe." The German researcher Marin Qaim estimates that the reduced use of insecticides by Indian farmers, thanks to GMO cotton, have avoided as many as 2.4 million cases of poisoning a year. And finally, a massive 2016 report by the US National Academy of Sciences concluded that the data do not support the assertion that cancer rates have increased

because of consuming GMO crops. Moreover, not just the NAS, but the AMA, the American Association for the Advancement of Science, the UK Royal Society, the French Academy of Science, the African Academy of Sciences, and numerous others agree. While 88% of American scientists believe it is safe to eat GMO foods, only 37% of US adults in the general public believe it is safe. The reason for this gap in consumer knowledge is clear: Anti GMO activists have peddled so much misinformation. Like emesis you can't put it back (save your dog), you cannot get the genie back in the bottle, and no amount of scientific knowledge can erase the lies.

THE BEST MADE PLANS OF MICE AND MEN...

A generation ago the Centers for Disease Control and Prevention (CDC) released a proposal to "Eliminate syphilis from the United States." The plan was a dismal failure. Almost as soon as it was issued infection rates began to head in the wrong direction. From year 2000 to 2006, the rates of syphilis quadrupled. Congenital syphilis, a nearly eradicated condition in which the infection is passed from mother to fetus, jumped 28%. This is really distressing because it is easy to diagnose and treat protecting the mother from the 40% chance of a stillbirth. Not limited to syphilis, sexually transmitted diseases (STDs) are roaring back as well. Chlamydia has nearly doubled and gonorrhea has more than doubled. What is going on? A few theories abide. The first is that CDC funding has been reduced to state health departments and clinics by 40% since 2003, and has continued to slide with current administrations. Another explanation is that sex is now seen as less risky. HIV is much less scary than generation ago for gay and bisexuals. Prophylactic pills taken daily can reduce the chance of infection by 99%. Condoms are cast aside and IUDs and birth control pills are seen as enough. STDs are surging in the UK as well with a 20 to 22% increase in syphilis and gonorrhea. One could even propose there is a cultural shift in moral behavior as persons of both sexes see no anxiety about limitations.

WHO SHOULD BE CAST AS JAMES BOND?

Cubby Broccoli and his wife saw Sean Connery in "Darby O'Gill and the Little People." No great actor but Ms. Broccoli liked his accent and his raw sex appeal. She said he would be a great James Bond. When asked to test for the part, Connery refused and said "Either take me as I am or not at all." Broccoli said what impressed them the most was he had balls.

ADDENDA

- Krispy Kreme is going to start opening shops at Walmart. They will offer an additional flavor, polyester.
- Eighty percent of married men cheat in America. The rest cheat in Europe.
- A foundation is a large body of money surrounded by people who want some.
- A man can have two, maybe three love affairs while he's married. After that he's cheating.
- Women speak two languages, one of which is verbal.
- Cats are smarter than dogs. You can't get eight cats to pull a sled through snow.
- Love is what happens to men and women who don't know each other.

ALOHA AND KEEP THE FAITH rts

(Editorial comment is strictly that of the writer.)

Guidelines for Publication of HJM&PH Supplements

The following are general guidelines for publication of supplements:

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