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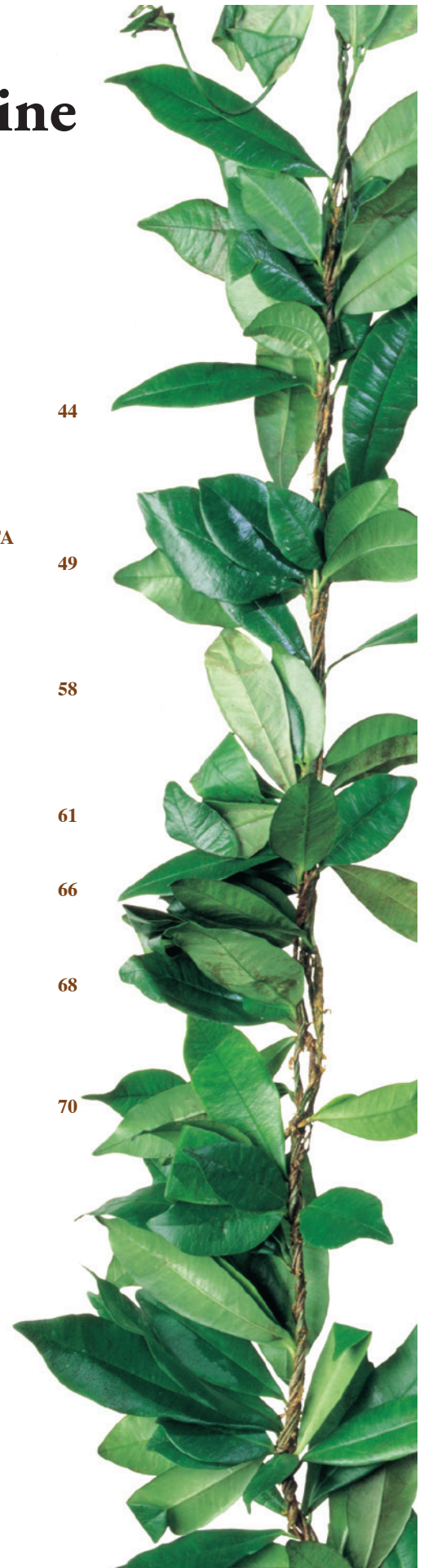
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Examining e-Health Literacy and the Digital Divide in an Underserved Population in Hawai'i

Kathleen Kihmm Connolly PhD and Martha E. Crosby PhD

Abstract

Seeking health information is one of the leading uses for the Internet and World Wide Web (WWW). Research has found the amount one benefits from e-Health information (health information from electronic sources) is directly related to the level of e-Health literacy. e-Health literacy is defined as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem." In order to gain a further understanding of the effects and use of technology, the digital divide, and the relationship between technology utilization and health outcomes, focus group interviews were conducted with participants diagnosed with diabetes and currently residing in a Medically Underserved Area. Overall, 25 volunteers participated in the four focus group meetings. Based on the focus group discussions, a general low e-Health literacy rate was identified. This was demonstrated by the lack of access to the Internet and the skills needed to retrieve health information. Of the 25 participants, 64% reported having Internet access at some level, but, only one reported going on the Internet every day. When the barriers to using the Internet were discussed, many participants expressed a lack of knowledge in how to retrieve information. Results of this study further show that having access to technology is not necessarily associated with usage. This dynamic is evolving into a new form of digital divide, gap in information retrieval and usage, versus gap in access. This is the first known study to examine e-Health literacy in an underserved population in Hawai'i. With the proliferation of information and communication technology and the transformation of information retrieval to be mobile and "on demand", a multi-pronged communication and education strategy is needed to explore how technology can improve e-Health literacy and health outcomes among underserved populations.

Introduction

Seeking health information is one of the leading uses for the Internet and World Wide Web (WWW). Research conducted by the Pew Research Center found that approximately 74% of adults use the Internet; 80% of those users seek information related to health.¹ In other words, 59% of all adults surveyed use the Internet for health information seeking activities. Searching and retrieving health information includes activities such as accessing blogs or news groups, watching online videos, reading drug or treatment reviews, and reading reviews on provider ratings.² Other health-related uses of the Internet include tracking weight, diet and exercise, social networking with health related groups, and fundraising for medical causes.² e-Health literacy is defined as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem."³ Research has found that e-Health literacy is associated with health outcomes. In other words, those who are more knowledgeable and capable in accessing e-Health information also have been shown to have better self-management of their health and health behavior, and greater interaction with their physician over the Internet.⁴ Research on Internet use for healthcare has shown that minority and underserved populations

are less likely to use technology compared to non-Hispanic whites and those with higher educational and financial resources. Common barriers were shown to be lack of computer access and knowledge on how to use the Internet and e-mail.⁵ Those who did not utilize information technology in managing their health were more likely to have poor control of their diabetes compared to those who did use the information technology. This is evidenced by poor management of blood glucose, blood pressure, and lipids.⁶ Thus, technology has the potential to influence health outcomes and not having access to the technology and computers, or the literacy skills that are needed to utilize these resources, can negatively influence one's health.

In the United States, research has shown that income is directly related to the adoption of information technology; the lower the income, the less often people access the Internet.¹ Access to broadband technology, or high speed Internet access, has been associated with younger age, higher education, and geographic location in urban areas.⁷ Hsieh and colleagues have shown that the strongest predictor of the use of information technology is one's socio-economic status.⁸ The division between those who have access to and use information technology (typically those who are younger, have higher education and income, and live in urban areas), and those who do not, is known as the "digital divide."

To our knowledge, no research exists examining e-Health literacy or the digital divide in Hawai'i. A comprehensive literature search conducted February 2013, found no published articles that explored e-Health literacy, computer literacy or the digital divide with underserved populations in Hawai'i. As part of a larger study of diabetes self-management, e-Health literacy was examined to gain a better understanding of the effects and use of technology, the Internet, and the digital divide among an underserved patient population.

Methods

Four focus group interviews were conducted among persons diagnosed with diabetes who resided in a Medically Underserved Area. Participants were recruited from a Federally Qualified Health Center that serves a Medically Underserved Area on the west side of O'ahu. Focus group sessions ranged from five to eight participants each session. An inductive method of analysis and data collection was utilized in conducting the focus groups. Open-ended questions were asked to elicit responses of how participants felt about technology and how technology affected their health status. Human use approvals were obtained from the University of Hawai'i (CHS #17909), the Health Center (IRB# 00006399) and the office of Research Protections, Hu-

man Research Protection Office, and the United States Army (A-15721.b). Written informed consent was obtained from all participants.

Data analysis included examining written notes, and listening to the audio taped sessions multiple times in conjunction with the notes to further gain an overall understanding of the interview as a whole; this method of data analysis has previously been reported.^{9,10} Themes were identified and indexed in conjunction with the written notes. In addition, relevant quotes were highlighted and sorted such that comparisons could be made between the focus group interviews. Audio was analyzed taking into context the social interactions, intonations, emotions and cultural inflections. The data were analyzed utilizing the analysis continuum of, (1) examining raw data, ie, flip charts and audio recordings, (2) using descriptions of context, and then, (3) interpreting or analyzing the data within the context of the research questions.¹¹ The context of topics, frequency of comments and intensity of comments were considered in the analysis.

Results

Overall, there were 25 volunteers who participated. Participant demographics were 56% female, mean age 54, mean education level was 12th grade, mean BMI 36.9, 68% Native Hawaiian, 52% unemployed, and 36% retired. See Table 1 for further description of participant demographics.

Several key themes emerged from the discussions. These themes can be categorized into two areas, first of which was the barriers to access and usage of computer technology. These included cost, knowledge on how to retrieve information, and access to the Internet. The second key theme was the motivation to learn and use the Internet for health information. This included family encouragement to learn, and an understanding that increasing one's health knowledge would be beneficial. Many of the participants stated that they were in the process of learning how to manage their health condition and were interested in learning more.

Of the 25 total focus group participants, 16 (64%) reported surfing the Internet at least sometimes, despite the fact that 16 (64%) of the participants reported having no computers at their home. Of the nine focus group participants (36%) reported having a computer with Internet available to them, four reported that they did not know how to access the Internet at all. Only one participant reported surfing the Internet every day and used the Internet for health information. Another participant stated that she used the Internet only for e-mail or gaming.

"I have a phone you can go on the Internet but don't know how to use... only know how to play Texas Hold'em" (Female, 54-years-old).

Many stated that they had relatives who owned computers that they have accessed on occasion. Also, many noted that their children or grandchildren used the computer to surf the net, but that they themselves did not know how.

Table 1. Participant demographics (N = 25)	
	Mean
Age	54 (SD = 11.6)
BMI	36.9 (SD = 9.3)
Frequency	
Sex	
Male	11 (44%)
Female	14 (56%)
Ethnicity	
Native Hawaiian	17 (68%)
Caucasian	4 (16%)
Other	4 (16%)
Marital Status	
Married	9 (46%)
Not Married	11 (41%)
Widowed	1 (3%)
Divorced	4 (10%)
Education	
High School	21 (84%)
Some College	4 (12%)
Employment Status	
Employed full-time	1 (4%)
Homemaker	1 (4%)
Unemployed	13 (52%)
Retired	9 (36%)
No response	1 (4%)
Household Income	
Less than \$30,000	16 (64%)
Less than \$40,000	3 (12%)
Don't know or prefer not to say	6 (24%)
Internet Usage	
Have Internet access	16 (64%)
Surf the Internet	
Everyday	1 (4%)
Sometimes	15 (60%)
Never	9 (36%)

"I went on with my sister once, only my sister knows how to work it." (Female, 40-years-old)

"I have a computer but only my grandson uses it. I don't know how." (Female, 62-years-old)

Among those who did not own computers, some mentioned accessing computers at the public library; however, they reported limited usage, citing long wait times and restrictions on maximum allotted time to one hour. Participants reported that there were no other known places in the local vicinity for

public access to the Internet. These results indicated that not owning a computer was not necessarily a barrier to accessing to the Internet, and availability of access to the Internet was not necessarily an indicator of usage.

The cost of purchasing and repairing computer equipment and Internet access were also discussed as barriers. In general, participants felt that it was difficult to obtain access to computers and the Internet.

"I don't have money [if had computer], would love it" (Female, 47-years-old)

"Yeah...I'm illiterate to that...It cost money, that stuff...I would go classes if someone gave me a computer." (Male, 72-years-old)

When assessed about their willingness to learn, many participants stated that they had family encouragement. In Hawaiian culture, the family, or 'ohana is an integral part of identity,¹² including one's health and wellness.¹³ Many participants stated that their children and grandchildren encouraged them to learn to use the Internet.

"My son says, Dad you gotta learn...you gotta do it yourself and learn the computer." (Male, 54-years-old)

Many of the participants stated that they are in the process of learning more about managing their health and would like to expand their knowledge even further.

"The computer it helps a lot, because, I mean for myself, the more information I got, I can balance the scales, because now I'm retaining more information than before, so now the more information I get, I can tweak my plan and my train of thought in how I'm going to make things easier for me...so the more knowledge I'm gaining, the more it is motivating me to work in different ways, instead of the same, same." (Male, 51-years-old)

Discussion

Based on the focus group discussions, low e-Health literacy was identified in many participants. This was demonstrated by the lack of knowledge on how to retrieve health information on the Internet. Only one participant was able to recall specific websites where health information is available. Very few participants were familiar with and able to search for health information on the Internet. Despite 64% of the group having Internet access, whether at home or elsewhere, only one participant discussed going online every day. This participant also enthusiastically reported retrieving health information from various sources such as WebMD.com. A few of the participants reported that they had Internet access via their cellular phones. Of those, only one of the focus group participants stated that they used their cellular phone for accessing the web; however, this participant reported only using her phone for email or to play games. One participant stated that he tried to access health information on the Internet, but was unable to find anything. Overall, the majority of participants reported either not having access to the Internet, or not knowing how to retrieve information online.

Other research studies that examined Internet usage in underserved populations also found that access to technology was not associated with e-Health literacy. For example, a study looking at low-income adults in the Midwestern United States found that limited health literacy was not correlated with access to computers and the Internet.¹⁴ This study found that low-income individuals did have access to the Internet, but were not able to retrieve information. The study indicated that participants were confused on how to search for information, with many not knowing how to open an Internet browser. It is speculated that retrieving information online was too overwhelming and confusing for those with limited health literacy. Hence, despite having access to the Internet, a lack of knowledge on how to retrieve information online was the barrier.

Consistent across all study participants was the willingness to learn and become more literate with both the computer and e-Health information. Participants stated that if courses were available, they would be willing to attend. Many participants noted that they currently receive health information from their healthcare providers and staff at the clinic. Several participants also reported that their family members, especially children and grandchildren, encouraged them to use the Internet for retrieving health information. Those that did surf the web had positive experiences. The few that were able to access health information found it to be helpful and empowering. All participants realized that learning more about Internet technology would help them to take personal responsibility for their health, and improve self-management of their chronic disease conditions; the participants noted that the Internet could be a source of empowerment. This enthusiasm to learn is consistent with other studies specifically looking at health literacy, which also found that despite the lack of use of Internet technology, participants were enthusiastic and wanted to learn and utilize information technology for diabetes care.¹⁵

There are several limitations to this study. Foremost, the extent to which participants underutilized the computer and the Internet was unknown at the beginning of the study. Since there were no published research articles on the digital divide or e-Health literacy with this population, it was assumed that the participant population was familiar with the Internet and the web. However, results revealed moderate access to broadband technology, and very low usage of the Internet for health information retrieval. A further limitation of the study was that participants were not systematically asked about how they accessed the Internet, for example by mobile phone or via a computer. Despite the many modes currently available, Internet access to health information was used as a general term.

Additionally, the majority of the participants reported being unemployed or retired. The mean age of the participants was 54 years; results from a younger population who are more likely to be digital natives (people using digital technology from childhood) would not be comparable. Therefore, the results are not representative of the population as a whole. Future research needs to include a more diverse participant population with participants who are employed, younger, and have experience

using the Internet. In addition, the use of focus groups can be subjective both in the participant discussion and in analysis of the data, thus results may not be generalizable to the targeted population. Finally, the sample was a convenience sample, which also limits the generalizability of the findings.

Conclusion

Despite the limitations of the study, the results contribute to the overall knowledge about computer literacy, e-Health literacy, and the digital divide in an underserved population in Hawai'i. Results showed that amongst a diabetic underserved population, despite access to the Internet, there was very low usage for accessing health information. However, this population is motivated to learn more about the Internet and how to retrieve e-Health information. The results of this study are consistent with several other studies that have examined the use of the Internet for e-Health information in underserved communities.¹⁶ For example, a study assessing health information seeking in a medically underserved community in Philadelphia also found that the digital divide was not in access to technology, but in information retrieval, understanding, and use.¹⁷ Future research in this area is needed to specifically address and parse out the variables that impact underserved populations and computer and technology utilization, including social support, computer access, computer literacy, e-Health literacy and education. Additionally, as technology access changes, such as with the availability of mobile devices, the digital divide is changing from a gap in access, to a gap in differentiation in the patterns of usage, ie, for information, education, or entertainment. The results of this study suggest that despite having Internet access, participants were not knowledgeable enough to access and utilize e-Health information on the Internet. The use and understanding of data available through information databases, social networks, and news, as opposed to mere access to broadband technology, is evolving into the new digital divide. With the proliferation of information and communication technology, and the transformation of information retrieval to being mobile and "on demand," a multi-pronged communication and education strategy is needed to explore how technology can improve e-Health literacy and health outcomes among underserved populations. In particular, mobile devices have evolved such that they now have the ability to circumvent many of the barriers to Internet access that previously affected low income and hard to reach populations. According to the United Nations Broadband Commission, mobile technology has the potential to bridge the gap between the connected and the unconnected, as evidenced by a predicted estimate of 2.1 billion mobile broadband subscriptions globally by end of 2013.¹⁸ As a result of the increase in mobile technology usage, the growth in mobile health (mHealth) applications in healthcare has expanded to include disease prevention, health promotion, treatment compliance, data collection, and disease surveillance.¹⁹ The usefulness of mHealth has been shown in underserved populations when used by community health workers to facilitate health education,

conduct person-to-person communication, collect health data, and receive alerts and reminders.²⁰ In an underserved migrant farm worker population, 81% of the participants reported their willingness to use mHealth services for managing chronic diseases such as diabetes or hypertension. Those that had no experience with mHealth were receptive to receiving training on how to use the technology.²¹

In sum, there is growing evidence that the use of Internet-based health information can help improve health outcomes. Telemedicine and Internet-based interventions have the potential to address access and quality of care by reaching a broader population base. Because Internet-based interventions are available 24 hours a day, they can effectively be used by the patient to self-manage chronic diseases. Educational, web-based applications can be tailored to the population, and can deliver culturally appropriate education and communication. The personalization of information, which is the tailoring of information to a particular user, provides relevance and context for the intended recipient.

Unfortunately, the digital divide does exist, as evidenced by disparities among those that use e-Health information, and disparities in the literacy skills needed to understand and use information. From a governmental standpoint, there is a large push for the development and dissemination of technology in healthcare to both remove barriers to care and improve access. And to a large extent, it is a public health issue that people are excluded from benefiting from the Internet and denied the use and understanding of health information that can help manage and improve health conditions.²² As such, in order to close the digital divide, computer literacy and e-Health literacy must accompany plans to expand programs to generate increases in e-Health usage in underserved areas.²³ Reiterated, further research and investigation is needed to understand which strategies would work best for an underserved population. In addition, information access is evolving at a rapid pace; whether it be desktop computers or mobile devices, research is needed to understand the best method for information access and what types of applications would best fit this population.

Conflict of Interest

None of the authors identify a conflict of interest.

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Maternal Asthma, Diabetes, and High Blood Pressure are Associated with Low Birth Weight and Increased Hospital Birth and Delivery Charges; Hawai'i Hospital Discharge Data 2003-2008

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Abstract

Asthma, diabetes, and high blood pressure are common maternal conditions that can impact birth outcomes. Data from hospital discharges in Hawai'i were analyzed for 107,034 singleton births from 2003-2008. Categories were determined using the International Statistical Classification of Diseases, ninth revision (ICD-9) from linked delivery records of mother and infant. Prevalence estimates of asthma (ICD-9: 493), diabetes (ICD-9: 250,648.0, 648.8), high blood pressure (ICD-9: 401-405,642) as coded on the delivery record, low birth weight (<2500 grams), high birth weight (>4500 grams), Cesarean delivery, and median hospital charges were calculated. Median regression analysis assessed total hospital charges adjusting for maternal age, maternal race, insurance, and Cesarean delivery. Maternal asthma was present in 4.3% (95% confidence interval=4.1-4.4%), maternal diabetes was present in 7.7% (95% CI=7.6-7.9%), and maternal high blood pressure was present in 9.2% (95% CI=9.0-9.3%) of births. In the adjusted median regression analysis, mothers with asthma had \$999 (95% CI: \$886 to \$1,112) higher hospital charges compared to those without; mothers with diabetes had \$743 (95% CI: \$636 to \$850) higher charges compared to those without; and mothers with high blood pressure had \$2,314 (95% CI: \$2,194 to \$2,434) higher charges compared to those without. Asthma, diabetes, and high blood pressure are associated with higher hospital delivery charges and low birth weight. Diabetes and high blood pressure were also associated with Cesarean delivery. An increased awareness of the impact of these conditions on both adverse birth outcomes and the development of chronic disease is needed.

Keywords

Chronic Conditions, Reproductive Health, Birth Outcomes, Hospital Charges

Introduction

Chronic disease is associated with morbidity and mortality, affects quality of life, and is associated with substantial health care expenditures. The Centers for Disease Control and Prevention (CDC) estimates that 70% of deaths among Americans each year are from chronic disease, as are 75% of the annual health care costs.¹ The primary prevention of chronic disease through improvement in modifiable risk factors such as physical inactivity, smoking, poor nutrition, and excessive alcohol consumption has the potential to improve the long term health of the population.² There have been significant increases in the prevalence of many chronic conditions and their risk factors among women of reproductive age (18-44 years) in the United States.^{3,4} Chronic conditions such as high blood pressure, diabetes, and asthma are also related to adverse reproductive health outcomes including the morbidity associated with Cesarean delivery, eclampsia, perinatal infections, preterm delivery, low birth weight, macrosomia, infant death, and increased health care utilization.⁵⁻¹⁶ The primary prevention of chronic disease in women before and between pregnancies can improve perinatal outcomes. Addressing the risk factors of chronic disease, as early as possible, including those identified during pregnancy

has the potential to promote overall health throughout the life course for women and their families.

In most populations in the United States, women are delaying birth of their first child to an older age, with an average maternal age at first birth of 25.0 years in 2006 compared to 21.4 years in 1970.¹⁷ These women may experience an increase in chronic conditions and the risk factors associated with them just by being older as well as due to the increases seen in the general population for chronic conditions, which may have an impact on their reproductive health outcomes. In the United States, the proportion of births to women aged 35 years and older increased from 8.8% in 1990 to 14.2% in 2008.¹⁸ The longer a woman has risk factors for chronic disease, or has been diagnosed with one or more chronic diseases, the higher the likelihood she may be in poorer health entering pregnancy, be at greater risk for adverse maternal and infant morbidity and mortality, and develop complications of chronic disease.¹⁹⁻²¹ With the increasing rates of chronic conditions and their risk factors in women of reproductive age,³ it is important to document the associated burdens through surveillance of chronic disease during pregnancy and associated birth outcomes.

Estimates of high blood pressure, diabetes, and asthma during pregnancy are largely unknown among the diverse Asian, Native Hawaiian, and multiple race population that lives in Hawai'i. National data on the leading causes of death among adult women in the aggregated Asian and Pacific Islander group show higher death rates for stroke, cancer, and diabetes than the estimate for all race and ethnic groups combined and above that of the non-Hispanic White group.²² Within the Pacific Islander group, data show Native Hawaiians and Other Pacific Islanders to be one of the highest risk populations for cardiometabolic diseases.²³ These higher rates of chronic disease among Asian and Pacific Islander populations highlight the importance of conducting surveillance and promoting chronic disease prevention at early opportunities throughout the life course, including during and shortly after pregnancy.

The goals of this analysis are to provide prevalence estimates of maternal asthma, high blood pressure, and diabetes among women who had a birth and to explore their associations with adverse birth outcomes and hospital charges for the diverse population in the State of Hawai'i. This surveillance can be used to establish baseline estimates of these maternal chronic conditions during pregnancy and provide data so that appropriate interventions can be developed to help improve reproductive health, reduce hospital charges, and decrease the overall burden of disease.

Methods

Hospital discharge data were obtained from the Hawai'i Health Information Corporation (HHIC)—a private, non-profit corporation that maintains a database of health care encounters in the State that occur in an emergency department or result in an inpatient hospitalization. The data collected are primarily administrative in nature, but include clinical data such as the International Statistical Classification of Diseases, ninth revision (ICD-9) codes, discharge disposition, birth weight, age, race, gender, hospital charges, and other limited data. The Hawai'i Department of Health requested a data set from HHIC that linked the mothers' and infants' birth records (>95% linkage rate). Analysis was limited to 107,034 linked mother-infant pairs for singleton births during 2003-2008.

Hospital discharge data are tied to billing for reimbursement of services and thus provide an opportunity for surveillance of conditions among women with a live birth. These data may better characterize the presence of maternal conditions compared to other data sources such as birth certificate information, which are known to underestimate the presence of maternal conditions when compared to hospital discharge data,^{24,25} or compared to actual medical records.²⁶ Maternal conditions were defined based on the presence of specific ICD-9 coding on any of the 20 available billing levels from the maternal record for each observation (Table 1). For high blood pressure, pregnancy associated (includes gestational hypertension, pre-eclampsia, and eclampsia) conditions were included due to their increasing recognition as risk factors for development of chronic disease.²⁷⁻²⁹ Women with either gestational diabetes or abnormal glucose tolerance identified during the pregnancy were considered to have diabetes due to the significantly increased risk of development of diabetes beyond the pregnancy for both of these diagnoses.²⁹⁻³² Although there are specific codes for hypertension and diabetes complicating the pregnancy, the general ICD-9 codes for these chronic conditions (250 Diabetes, and 401-405 for Hypertension) were included to identify these conditions that were not recorded under a pregnancy related codes. This had little impact and identified only 10 additional cases for diabetes (0.1% of all diabetes diagnoses) and 10 additional cases for high blood pressure (0.1% of all high blood pressure diagnoses). For asthma, no specific code related to pregnancy exists so only the general ICD-9 code for the chronic condition was used. The focus of this analysis was to combine those with a pre-existing chronic condition and those with onset during pregnancy and see the impact on birth outcomes. Based on the diagnostic codes, 75% of those who were defined as having high blood pressure had onset with the pregnancy while 25% had chronic high blood pressure prior to or complicating the pregnancy. This was somewhat different from those who were defined as having diabetes where 88.3% had diabetes with an onset with the pregnancy and only 11.7% having had it prior to the pregnancy. These distributions were skewed towards those with an onset of the condition during pregnancy for both of these estimates and suggests the importance of providing appropriate anticipatory guidance related to the risks of developing chronic high blood pressure and diabetes post-partum.²⁷⁻³²

Table 1. International Statistical Classification of Diseases, Ninth Revision (ICD-9) Codes Used to Define Maternal Conditions

Maternal Condition	ICD-9 Coding
Asthma	493
Diabetes	250, 648.0, 648.8
High Blood Pressure	401-405, 642

Outcomes

Birth Weight

Infant birth weight is related to the rate of fetal growth and gestational duration of the pregnancy. It is strongly related to both newborn morbidity and mortality and is a key population level indicator for maternal and child health.³³ Birth weight was obtained from the newborn record and categorized as low birth weight (LBW: <2,500 grams) and high birth weight (HBW: >4,500 grams).

Delivery Type

A Cesarean delivery is a major surgery that is typically performed in the presence of pregnancy complications that could jeopardize the health of the mother and/or fetus. The rate of Cesarean delivery has steadily increased in the United States from 5.8% in 1970 to 32.3% in 2008 but has not been associated with significant improvement in neonatal morbidity or maternal health.³⁴ For this analysis, delivery type was based on the newborn record with an ICD-9 code of 'V3000' signifying a vaginal delivery and a code of 'V3001' representing a Cesarean delivery; analyses were restricted to singleton births. The delivery type variable was also used to stratify results for hospital charges due to differences between vaginal and Cesarean deliveries for these outcomes.

Total Hospital Charges

Hospital charges were obtained from both the newborn's and the mother's records. Records with no information on hospital charges (14.4%, n=15,458) were excluded from this part of the analysis, and largely represented births from military hospitals (n=15,440) that do not report charge data to HHIC. Records with military insurance (n=1,367) that had charge information were included in the analysis. Total hospital charges were obtained by summing newborn and maternal charges.

Selected Maternal Characteristics

Age was based on mother's age on admission and categorized as <20, 20-24, 25-29, 30-34, and 35 years and older. Self-identified race/ethnicity included White, Black, Hawaiian, Filipino, Japanese, and "Other." The "Other" racial group included those who indicated more than one race, and those for whom race did not fall into one of the above categories. Those with race information listed as "unknown," "not applicable," or "not collected" accounted for 18.6% of records and are referred to as "unknown" in this report. Geographic variation was categorized into county of residency based on the mailing address reported at delivery. Insurance status was based on payer listed on maternal delivery

record and was categorized as “None,” “Medicaid/QUEST,” “Military,” or “Private” insurance.

Analysis

Prevalence estimates and 95% confidence intervals (95% CI) based on exact binomial proportions³⁵ were calculated for each chronic condition by selected maternal characteristics. For the continuous variable of hospital charges, the medians are presented and two-sided Wilcoxon-Mann-Whitney tests were used to compare median differences between those with and without the chronic condition. A small percentage of the population accounted for a large percentage of the hospital charges, reflecting a skewed distribution. The log-transformed total hospital charges were not normally distributed so the more robust median (50th quantile) regression analysis on the untransformed charges was performed to better account for the positively skewed distribution of this variable.³⁶ A median regression analysis based on the SAS QUANTREG procedure was used to assess the effect of chronic conditions on total hospital charges while accounting for the potential confounding factors of maternal age, maternal race, maternal insurance, and delivery type. SAS v9.2 (SAS Institute Inc, Cary, North Carolina) statistical software was used for analysis.

Results

Overall in Hawai‘i, in this 6-year aggregate of singleton births, nearly three quarters of births occurred in women 20-34 years of age, with about 25% in each of the middle three age groups (20-24, 25-29, and 30-34 years) (Table 2). The most common race groups represented were Hawaiian (18.7% of births), Filipino (15.6%), and White (14.3%). Of particular note is that 20.7% of births had a race classified as “other” and 18.6% had no information related to race in the data—representing a combined 39.3% of births without a specific race group noted. Just over half the births were to those with private insurance, nearly one-third were to those on Medicaid/QUEST insurance, and 15.7% were to those with military insurance.

The occurrence of an asthma diagnosis decreased with increasing maternal age, and was highest among those of Hawaiian race and lowest among those of White and Chinese race (Table 3). The prevalence of a diagnosis of asthma was higher among those on Medicaid/QUEST insurance and those living in Honolulu County. Those with an asthma diagnosis had higher proportions of low birth weight infants, but no difference in high birth weight or cesarean sections compared to mothers without asthma (Figures 1-3). Total median hospital charges were higher among those with an asthma diagnosis compared to those without (Table 4). Those with an asthma diagnosis also had higher total median hospital charges in both cesarean and vaginal deliveries compared to those without an asthma diagnosis.

The occurrence of diabetes increased with increasing age and was higher among those of Filipino and Chinese race (Table 3). A diagnosis of diabetes was more common among those with private and military insurance and those living in Honolulu and

Table 2. Selected Characteristics of Women Who Had Singleton Births, HHIC*, 2003-2008

	n	Proportion (%)
Age Group (years)		
<20	9,166	8.6%
20-24	26,624	24.9%
25-29	28,291	26.4%
30-34	24,688	23.1%
>=35	18,264	17.1%
Subtotal	107,033	
Race		
White	15,357	14.3%
Black	500	0.5%
Hawaiian	20,063	18.7%
Filipino	16,671	15.6%
Japanese	9,668	9.0%
Chinese	2,699	2.5%
Other	22,175	20.7%
Unknown	19,901	18.6%
Subtotal	107,034	
Insurance		
None	1,622	1.5%
Medicaid/QUEST	32,825	30.7%
Military	16,807	15.7%
Private	55,624	52.0%
Subtotal	106,878	
County of Residence		
Hawai‘i	13,364	12.6%
Honolulu	76,641	72.3%
Kaua‘i	4,754	4.5%
Maui	11,285	10.6%
Subtotal	106,044	
Total	107,034	

*Note: HHIC represents data from the Hawai‘i Health Information Corporation

and Kaua‘i Counties. Women with a diagnosis of diabetes had a higher percentage of low birth weight, high birth weight, and Cesarean section deliveries than women without a diagnosis of diabetes (Figures 1-3). Total median hospital charges were higher among those with a diagnosis of diabetes compared to those without (Table 4). Those with a diagnosis of diabetes also had higher total median hospital charges in both Cesarean and vaginal deliveries compared to those without a diagnosis of diabetes.

The occurrence of high blood pressure was higher in both the younger and the older age groups with those aged 25-29 years having the lowest estimates (Table 3). A diagnosis of high blood pressure was higher among those of Filipino, Hawaiian, and “unknown” race (Table 3). It was also more common among those with military insurance and those living in Honolulu and

Table 3. Prevalence Estimates of Asthma, Diabetes, and High Blood Pressure Among Women Who Had Singleton Births, by Selected Maternal Characteristics, HHIC*, 2003-2008

	Asthma			Diabetes			High Blood Pressure		
	Count	Prevalence (%)	95% CI	Count	Prevalence (%)	95% CI	Count	Prevalence (%)	95% CI
Age Group (years)									
<20	492	5.4	(4.9-5.8)	219	2.4	(2.1-2.7)	847	9.2	(8.7-9.8)
20-24	1,216	4.6	(4.3-4.8)	1,041	3.9	(3.7-4.1)	2,503	9.4	(9.1-9.8)
25-29	1,152	4.1	(3.8-4.3)	1,944	6.9	(6.6-7.2)	2,194	7.8	(7.4-8.1)
30-34	1,019	4.1	(3.9-4.4)	2,519	10.2	(9.8-10.6)	2,171	8.8	(8.4-9.2)
>=35	682	3.7	(3.5-4.0)	2,524	13.8	(13.3-14.3)	2,080	11.4	(10.9-11.9)
Race									
White	453	3.0	(2.7-3.2)	665	4.3	(4-4.7)	1,002	6.5	(6.1-6.9)
Black	32	6.4	(4.3-8.6)	32	6.4	(4.3-8.6)	46	9.2	(6.7-11.7)
Hawaiian	1,343	6.7	(6.4-7.0)	1,411	7.0	(6.7-7.4)	2,014	10.0	(9.6-10.5)
Filipino	712	4.3	(4.0-4.6)	1,884	11.3	(10.8-11.8)	1,728	10.4	(9.9-10.8)
Japanese	375	3.9	(3.5-4.3)	852	8.8	(8.3-9.4)	670	6.9	(6.4-7.4)
Chinese	74	2.7	(2.1-3.4)	312	11.6	(10.4-12.8)	148	5.5	(4.6-6.3)
Other	942	4.3	(4.0-4.5)	1,665	7.5	(7.2-7.9)	1,712	7.7	(7.4-8.1)
Unknown	630	3.2	(2.9-3.4)	1,426	7.2	(6.8-7.5)	2,475	12.4	(12-12.9)
Insurance									
None	30	1.9	(1.1-2.5)	72	4.4	(3.4-5.4)	77	4.8	(3.7-5.8)
Medicaid/QUEST	1,875	5.7	(5.5-6.0)	2,033	6.2	(5.9-6.5)	2,882	8.8	(8.5-9.1)
Military	551	3.3	(3.0-3.6)	1,203	7.2	(6.8-7.6)	2,178	13.0	(12.5-13.5)
Private	2,088	3.8	(3.6-3.9)	4,916	8.8	(8.6-9.1)	4,637	8.3	(8.1-8.6)
County of Residence									
Hawai'i	202	1.5	(1.3-1.7)	728	5.5	(5.1-5.8)	1,197	9.0	(8.5-9.4)
Honolulu	4,188	5.5	(5.3-5.6)	6,469	8.4	(8.2-8.6)	7,689	10.0	(9.8-10.3)
Kaua'i	54	1.1	(0.8-1.4)	370	7.8	(7.0-8.5)	325	6.8	(6.1-7.6)
Maui	76	0.7	(0.5-0.8)	618	5.5	(5.1-5.9)	487	4.3	(3.9-4.7)
Overall	4,561	4.3	(4.1-4.4)	8,247	7.7	(7.6-7.9)	9,795	9.2	(9.0-9.3)

*Note: HHIC represents data from the Hawai'i Health Information Corporation

Table 4. Median Hospital Charges Among Singleton Births for Presence or Absence of Chronic Conditions, Overall and by Delivery Type, HHIC*, 2003-2008

	Median Charge	Median Charge (Cesarean)	Median Charge (Vaginal)
Asthma	\$9,988.00	\$14,926.00	\$9,025.00
no Asthma	\$8,918.00	\$12,926.00	\$7,997.00
P-value **	<.001	<.001	<.001
Diabetes	\$10,701.00	\$13,807.00	\$9,002.00
no Diabetes	\$8,848.00	\$12,908.50	\$7,984.00
P-value	<.001	<.001	<.001
High Blood Pressure	\$11,785.00	\$16,240.00	\$9,971.50
no High Blood Pressure	\$8,775.00	\$12,764.00	\$7,928.00
P-value	<.001	<.001	<.001
Overall	\$8,968.00	\$13,000.00	\$8,041.00

*Note: HHIC represents data from the Hawai'i Health Information Corporation. Charges not available for births occurring at military facilities (n= 15,440 births) and for 5 births with Quest and 13 with Private Insurance. There were 1,367 births with military insurance had charges—occurred at non-military facilities.

**P-value denotes difference by a two-sided Wilcoxon-Mann-Whitney test among those with the conditions vs not having the condition.

Table 5. Univariate (Crude) and Multivariable (Adjusted*) Analyses of Total Hospital Charges Among Those with and Without Selected Chronic Diseases, HHIC*, 2003-2008

Parameter	Univariate Analysis		Multivariable Analysis**	
	β^{\dagger}	95% CI***	β^{\dagger}	95% CI
Intercept	-	-	7,552	(7,379 - 7,726)
Asthma				
Yes	1,070	(903 - 1,237)	999	(886 - 1,112)
No	Reference		Reference	
Diabetes				
Yes	1,853	(1,727 - 1,979)	743	(636 - 850)
No	Reference		Reference	
High Blood Pressure				
Yes	3,010	(2,836 - 3,184)	2,314	(2,194 - 2,434)
No	Reference		Reference	

*Note: HHIC represents data from the Hawai'i Health Information Corporation. †Regression coefficients are derived from median regression analysis.
 Adjusted for Age group, Race group, Maternal Insurance, and Cesarean Section. * 95% CI refers to the 95% Confidence Interval

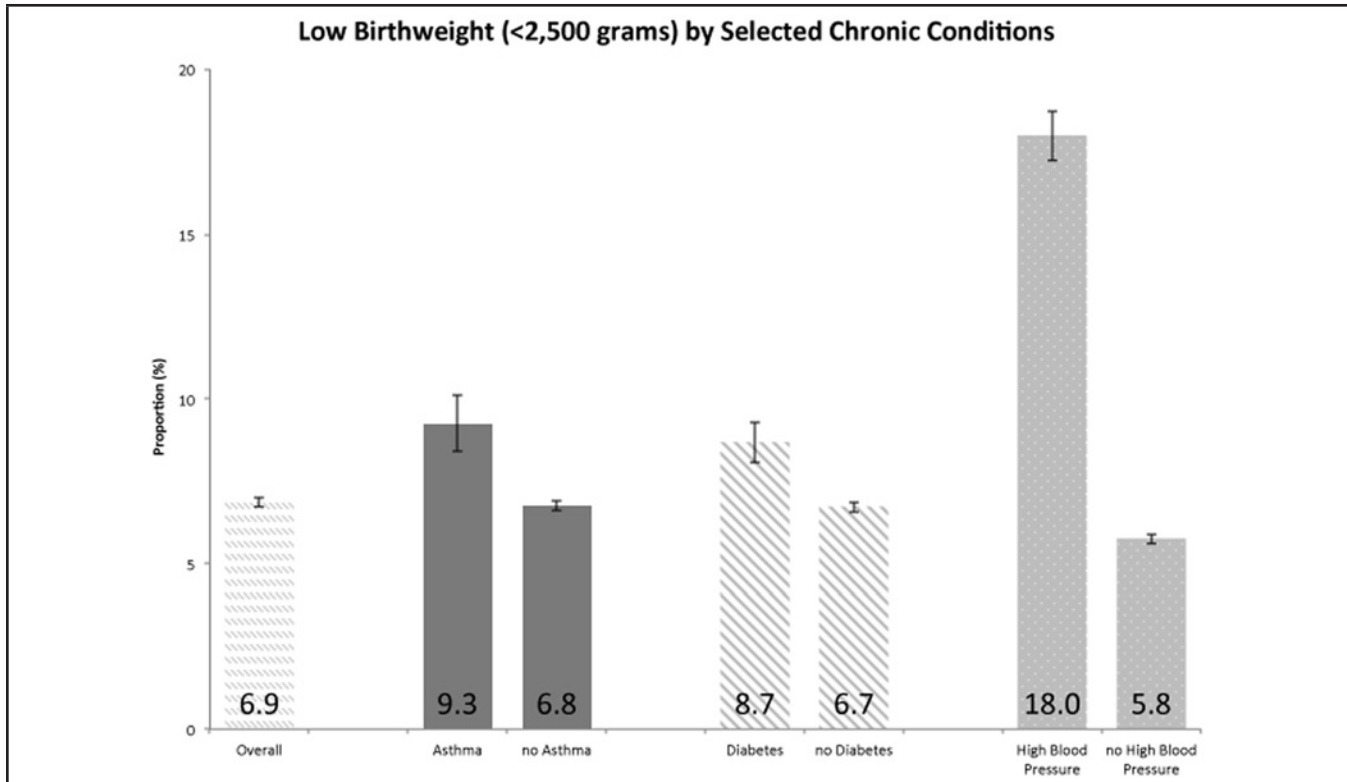


Figure 1. Proportion of Low Birth Weight (<2,500 grams), Overall and by Selected Chronic Conditions, Hawai'i Health Information Corporation, 2003-2008 Singleton Births.

Hawai'i Counties. Those with a diagnosis of high blood pressure had higher proportions of low birth weight and Cesarean sections, but no difference for high birth weight as compared with mothers without high blood pressure (Figures 1-3). Total median hospital charges were higher among those with a diagnosis of high blood pressure compared to those without (Table 4). Those with a diagnosis of high blood pressure also

had higher total median hospital charges in both Cesarean and vaginal deliveries compared to those without the diagnosis.

In the median regression analysis, an asthma diagnosis was associated with a \$999 (95% CI: \$886 to \$1,112) higher median charge compared to those without after controlling for the two other conditions and maternal age, maternal race, insurance, and cesarean delivery (Table 5). A diagnosis of diabetes was

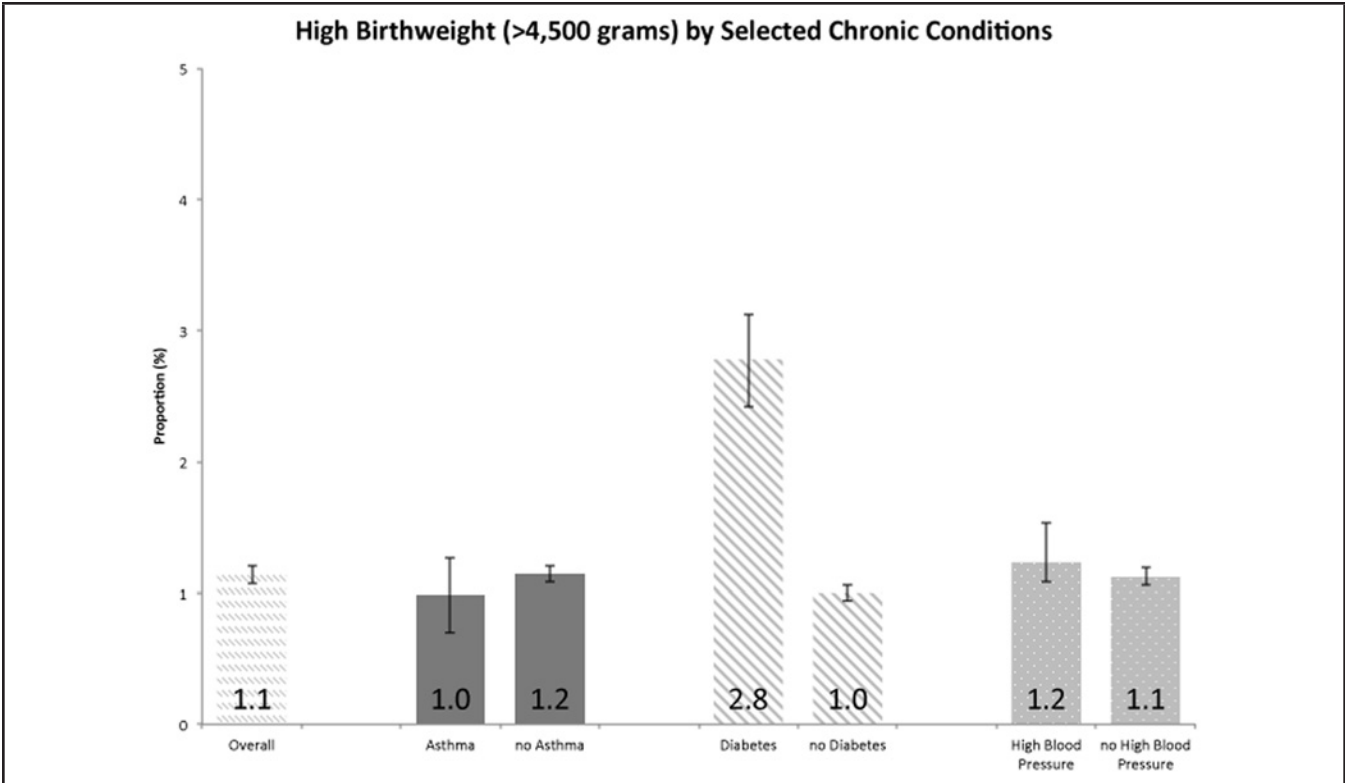


Figure 2. Proportion of High Birth Weight (>4,500 grams), Overall and by Chronic Condition Conditions. Hawai'i Health Information Corporation, 2003-2008 Singleton Births.

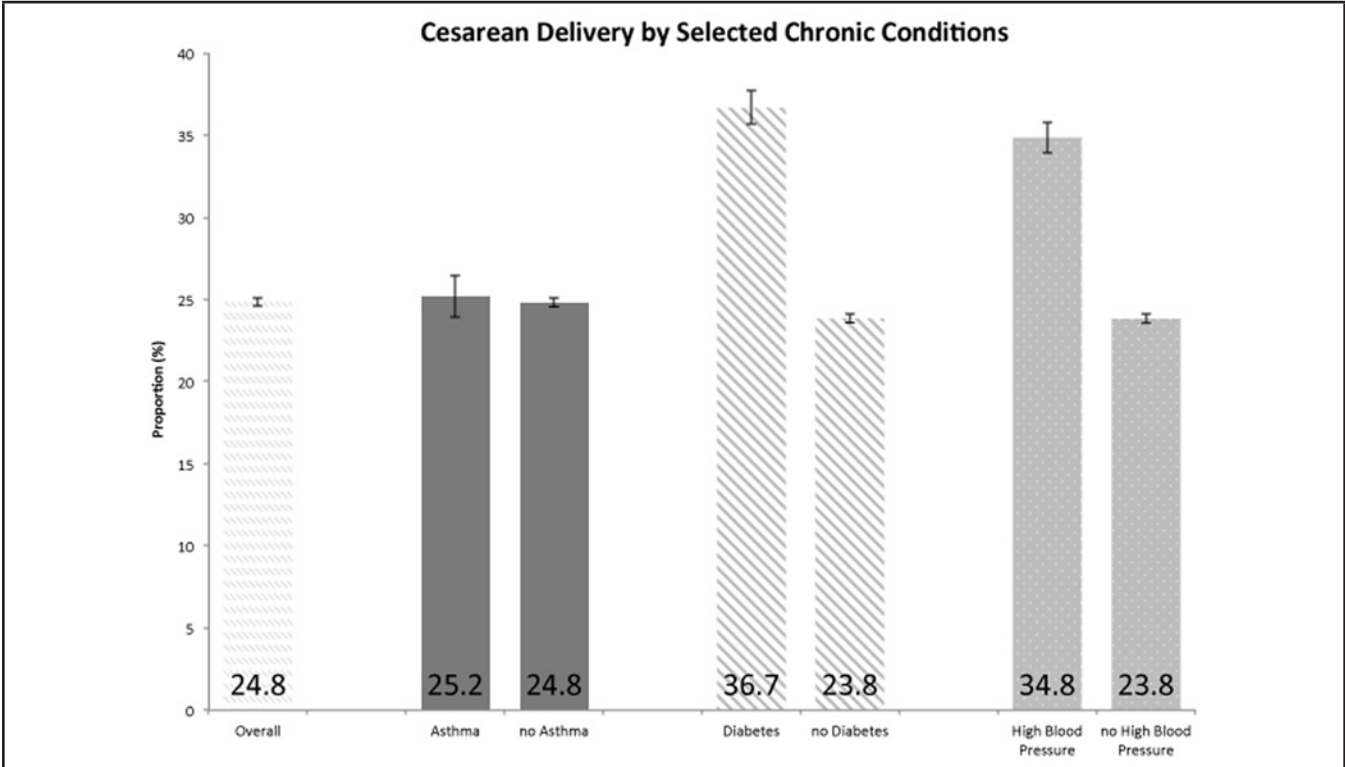


Figure 3. Proportion of Cesarean Delivery, Overall and by Selected Chronic Conditions, Hawai'i Health Information Corporation, 2003-2008 Singleton Births.

associated with a \$743 (95% CI: \$636 to \$850) higher median charge compared to not having a diagnosis of diabetes after controlling for other conditions and characteristics. A high blood pressure diagnosis was associated with a \$2,314 (95% CI: \$2,194 to \$2,434) higher median charge compared to those without a high blood pressure diagnosis after controlling for other conditions and characteristics.

Discussion

This study highlighted that nearly 1 in 10 women who delivered a baby in Hawai'i have a diagnosis of high blood pressure, about 1 in 12 have a diagnosis of diabetes, and about 1 in 25 have a diagnosis of asthma as reflected in hospital discharge delivery record. Further, these women had more adverse birth outcomes and higher hospital charges compared to those without one of these conditions. The burden of chronic disease among women of reproductive age is expected to increase, particularly with the rise in chronic disease in younger populations. Efforts to promote healthy lifestyle choices can prevent or delay the development of disease throughout the life course. Efforts focused among women of reproductive age have the potential to also improve reproductive health outcomes.

There is a growing awareness of asthma and potential links to health and quality of life in the general population. The prevalence of ever being diagnosed with asthma in the general population of US women of reproductive age (18-44 years) in 2009 was estimated to be 16.2%, an increase of 20% since 2001.³ Estimates for current asthma in women of reproductive age in Hawai'i from 2010 Behavioral Risk Factor Surveillance System (BRFSS) data was 13.3% compared to 21.3% for ever being diagnosed with asthma, which are both significantly higher than national estimates.³⁷ The estimates from hospital discharge delivery records are much lower when compared to estimates of both current and having ever been diagnosed with asthma and may be related to under-reporting of the condition in this administrative record. Women with an asthma diagnosis in the hospital discharge delivery records may represent those with more severe disease than other mothers who had milder forms of asthma. Additionally, unlike chronic high blood pressure and chronic diabetes, there is no specific pregnancy related diagnostic code for asthma, which may also contribute to under-reporting of this disease. Estimates from Hawai'i BRFSS data show the highest levels of asthma among women of reproductive age in Hawai'i County,³⁷ whereas this study revealed the highest level in Honolulu County, so there may also be some differential reporting of asthma in hospital discharge delivery records related to geography. The relationship between maternal asthma and low birth weight represents a possible explanation for the higher hospital charges compared to those without asthma. This is consistent with some of the general literature showing associations between asthma and low birth weight.^{10,38} Of the three birth outcomes examined comparing those with to those without Asthma, there was only a significant difference in low birth weight. Thus, the finding of higher hospital charges for those with asthma compared to those with diabetes, which is

associated with all three adverse birth outcomes, was unexpected and highlights that charges are likely not just related to increased adverse birth outcomes.

A diagnosis of diabetes was listed in 7.7% of the hospital discharge delivery records in our study, which is consistent with the general literature and highlights that diabetes diagnoses may be well captured by the data. Estimates in the general population of women of reproductive age, using BRFSS data, highlighted that 5.8% reported having had either chronic or gestational diabetes in 2008 and that 2.9% had chronic diabetes in 2009.^{3,39} A population limited to those who are pregnant would explain the higher estimates of diabetes when compared to all women of reproductive age. Of the three adverse birth outcomes examined, there were significant differences between mothers with compared to those without diabetes among all of them (high birth weight, low birth weight, and cesarean delivery). Thus, the increased costs found in this study were expected as these outcomes are likely associated with higher hospital charges. Women diagnosed with gestational diabetes have a seven-fold greater risk of developing chronic diabetes later in life, compared to those who did not have gestational diabetes.³⁰ Even those with just an abnormal glucose screen in pregnancy (but normal follow up testing for gestational diabetes) are at increased risk for development of diabetes later in life.³¹ Although nearly all the diagnoses in our study (88.%) were related to the pregnancy specific billing codes, the increase risk of developing chronic diabetes among those with pregnancy related diabetes highlights the importance of ensuring that these women have appropriate treatment during pregnancy and follow up after delivery. Diabetes identified during pregnancy appears to be an early clinical marker of risk, and appropriate follow up in the postpartum period may help decrease the burden of disease. The American Diabetes Association recommends that mothers who had gestational diabetes be screened six to twelve weeks postpartum and then every three years to identify as early as possible those who develop chronic diabetes.⁴⁰

High blood pressure was diagnosed in 9.2% of all hospital deliveries, which is also consistent with the general literature. A recent clinical review highlighted that 5-10% of all pregnancies are affected by hypertensive disorders (all subtypes) and that these hypertensive disorders in pregnancy were associated with severe morbidity as well as increased maternal, fetal, and infant mortality.⁴¹ The variation by race group shown in our study is consistent with that seen in the general adult population for Hawai'i with Hawaiian and Filipino race groups having the highest rates of diagnosed high blood pressure.⁴² Those with high blood pressure diagnoses accounted for the highest charges of the three chronic conditions evaluated in this paper and were consistent across delivery type with the highest median charges in both cesarean and vaginal delivery. Associations among high blood pressure, low birth weight, and cesarean delivery provide a likely explanation for the increased overall charges found among affected women. High blood pressure during pregnancy is increasingly being recognized to have long-term adverse consequences to mothers and children.^{28,29} A recent

review showed a nearly 4-fold greater risk of hypertensive disease at a mean of 14 years after pregnancy among those with preeclampsia compared to those who had normal blood pressure during pregnancy.²⁹ Although nearly all the diagnoses in our study (75%) were related to the pregnancy billing codes, the increase risk of developing chronic hypertension among those with pregnancy related high blood pressure highlights the importance of ensuring that these women have appropriate treatment during pregnancy and follow up after delivery. High blood pressure identified during pregnancy appears to be an early clinical marker of cardiovascular risk, and appropriate follow up in the postpartum period may help decrease the burden of heart disease. The American Heart Association Effectiveness Based Guidelines for the Prevention of Cardiovascular Disease in Women identifies women with a history of pre-eclampsia, gestational diabetes, or pregnancy related hypertension to have a major risk factor for cardiovascular disease and supports the importance of appropriate follow up in these women postpartum.⁴³

Clinical visits such as those related to preconception and interconception services provide opportunities to help address chronic conditions among women who have had or are planning a pregnancy. The vast majority of those with high blood pressure and diabetes did not have a diagnosis prior to pregnancy. This finding reinforces the importance of providing appropriate education in the interconception period related to the increase risks of developing chronic disease. With the appropriate training, clinicians can use these opportunities to promote healthy lifestyles which could lead to reductions in adverse reproductive outcomes,⁴⁴⁻⁴⁶ as well as reductions in the development and morbidity associated with chronic disease.⁴⁷ Additionally, population level efforts, such as the CDC Healthy Communities Program, could help reduce the burden of chronic disease and achieve health equity in 52 state and territorial health departments and 331 communities nationwide through sustainable change where people live, learn, work and play.⁴⁸ The Healthy Communities Program focuses on healthy choices related to tobacco, physical inactivity, and unhealthy eating which are also likely to improve reproductive outcomes by promoting these same health behaviors in women of reproductive age.

The findings in this report are subject to at least six limitations. First, hospital discharge data is an administrative data set and may under-estimate the prevalence of maternal chronic conditions compared to clinical records if the data are not in the hospital record used to generate the billing codes as shown for diabetes and other chronic conditions.^{25,49,50} Thus actual medical records, including outpatient records, may be more appropriate for a true surveillance of chronic disease in pregnancy. Secondly, each maternal condition was treated independently in the base analysis and does not account for the potential of clustering of these conditions which could potentially explain some of the differences seen between the conditions, but the sample sizes to investigate this clustering were not sufficient in this data set. However, the inclusion of all three conditions in the median regression analysis did partly account for this possibility by the

inclusion of all three conditions in the model simultaneously. Third, the associations seen with diabetes and high blood pressure represents those for the aggregated measures including those with the chronic condition prior to the pregnancy compared to those who developed the condition associated with the pregnancy. Despite the increased risk for long term chronic disease in those with pregnancy associated conditions, there could be differential outcomes if the conditions are disaggregated which may lead to an under or over estimation of the actual hospital charges and other birth outcomes evaluated in this study. The focus of this study was to evaluate the impact of these aggregated measures so this differential was not assessed within the framework of this analysis, but highlights some potential areas for future work. Fourth, we could not examine the actual level, treatment, or control of these conditions (eg, changes in diabetes, high blood pressure, or asthma over time due to behavioral and pharmacological means) that could influence the impact on the pregnancy and contribute to birth outcomes. Additionally, the available demographic data are limited in detail, particularly as related to racial identification and other measures that are often associated with adverse birth outcomes. For example, one hospital, whose births comprise approximately 15% of state births, does not report information about race; hence, the race for mothers giving birth there was classified "Other." Some other measures that could not be addressed in the analysis include the social determinants of health, such as education, employment, social support, and living environments that may result from long-term health inequalities.⁵¹ Lastly, the true burden of the impact of these conditions should include assessment for any longitudinal outcomes such as increased morbidity and mortality that may result after the hospital admission for birth, which are not available within the data used for this analysis.

Additional analysis could evaluate the increased costs associated with asthma and the inter-relations between these chronic conditions and their associations with both adverse birth outcomes, but also longitudinally evaluate the increased utilization of health services in those identified initially with chronic conditions or their strong risk factors during pregnancy. The collection of more information related to specific subpopulations could allow a better assessment of variation and disparities among groups such as within the Asian and Pacific Islander subgroups. Addressing risk factors by encouraging healthy lifestyle choices throughout the life span and in multiple settings will likely lead to reductions in the severity of chronic diseases, improve the quality of life for individuals, and also promote healthy pregnancy outcomes. Ensuring that women who are diagnosed with pregnancy related diabetes and high blood pressure receive appropriate postpartum care as recommended by the American Heart Association and the American Diabetes Association are important foci, and can contribute to other multi-disciplinary approaches emphasizing chronic disease prevention at every age. However, it will be important to monitor the effectiveness of these initiatives to reduce chronic disease and improve birth outcomes through appropriate evaluation to assess the impact of these interventions. An increased aware-

ness of the impact of these conditions on both adverse birth outcomes and the development of chronic disease is needed.

Conflict of Interest

None of the authors identify a conflict of interest.

Disclaimer

The findings and conclusions in this article are those of the authors and do not represent the official position of the Centers for Disease Control and Prevention or the Hawaii Department of Health.

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Diagnosis of Intussusception Using Bedside Ultrasound by a Pediatric Resident in the Emergency Department

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Abstract

The use of bedside ultrasound in the emergency department has been gaining favor among emergency medicine physicians and can be invaluable in the prompt diagnosis and treatment of acutely ill patients, especially when radiology evaluation is unavailable or delayed. Although pediatric ultrasound examinations are taught in some pediatric residency programs, they are not part of the required pediatric residency curriculum in the United States. This is the first case report of a pediatric resident diagnosing intussusception by bedside ultrasound in a 4-year-old boy under the guidance of a pediatric emergency attending with ultrasound training. This report illustrates the ease of using bedside ultrasound even among early learners and highlights its potential importance in medical education for fellows and residents.

Keywords

intussusception, ultrasound, emergency medicine, medical education, pediatrics, residents, radiology

Introduction

The use of bedside ultrasound in the emergency department (ED) has been increasing among adult emergency medicine physicians and more recently among pediatric emergency medicine physicians. Among pediatric emergency fellowship program directors, 94% have expressed interest in ultrasound skills training,¹ with a few pediatric emergency medicine fellowship programs integrating a 2-4 week ultrasound rotation into training.² There have been increasing reports of the use of bedside ultrasound in pediatric emergency medicine in cases involving pediatric trauma, adolescent pregnancy, and intussusception.³⁻⁵

Intussusception occurs when part of the gastrointestinal tract telescopes into an adjacent distal segment and is the most common cause of intestinal obstruction in children between three months and six years of age with an incidence of 38 per 100,000 cases in the first year of life and 31 per 100,000 cases in the second year of life.⁶ If not promptly diagnosed and treated with enema reduction, intussusception can lead to intestinal necrosis, sepsis, or death.⁷ The classical presentation of intussusception consists of the triad of colicky abdominal pain, bloody stool (commonly described as “currant jelly”), and vomiting. While the presence of this triad has a positive predictive value of 93% for intussusception, it unfortunately occurs in less than 25% of cases. Many patients instead present with varying combinations of non-specific symptoms including vomiting, abdominal pain, excessive crying, or lethargy and may initially be misdiagnosed with other abdominal and neurological conditions.^{8,9}

While the gold standard for diagnosis of intussusception has been contrast enema, the use of ultrasound has been gaining favor as the initial study choice due to being non-invasive, radiation-free, painless, fast, and relatively low in cost compared to other radiological procedures. If evaluation by a radiologist

is delayed or unavailable, a bedside ultrasound performed by a trained physician in the ED can be crucial in reducing the time to diagnosis and definitive treatment. Although the test characteristics of an ultrasound examination for intussusception greatly depend on user experience, multiple international studies have shown that the sensitivity and specificity of ultrasound are high and range between 96.6% to 100% and 88% to 100%, respectively.^{7,10-13} Studies of radiology residents and emergency medicine physicians have suggested that the technique is relatively easy and can be taught quickly.¹⁴ This is the first case report of a pediatric resident (KWR) with no prior radiology training successfully performing bedside ultrasound for intussusception.

Case Report

A previously healthy 4-year-old boy presented to an ED with a two day history of abdominal pain and non-bilious, non bloody vomiting. He was given a suppository for suspected constipation that resulted in a non-bloody bowel movement and relief of pain. However, he returned to the ED the following day due to worsening abdominal pain occurring every 5 to 20 minutes. An ultrasound was performed and read by the radiologist as positive for intussusception. The patient was transferred to a tertiary pediatric facility where he was seen by a third year pediatric resident (KWR). His examination revealed a soft and non-distended abdomen with audible bowel sounds. He had tenderness in the right lower quadrant but no palpable mass. The rest of the exam was unremarkable. Intravenous fluids were started and morphine was given for pain control. The transferred patient did not arrive with any radiographic images from the referring ED. Under guidance from a pediatric emergency medicine attending trained in pediatric ultrasound, the pediatric resident performed a bedside ultrasound for intussusception for her first time and was able to obtain images of the target sign and the hayfork sign typical of intussusception (Figures 1 and 2). An ultrasound read by the radiologist confirmed the diagnosis of ileocolic intussusception, which was successfully reduced with contrast enema with gastrografin. The patient was admitted for overnight observation per protocol and was discharged the following day without complications.

Discussion

Intussusception has a characteristic appearance on ultrasound. Using warm gel and a 10 MHz linear transducer, the examiner begins the ultrasound exam at the cecum in the right lower quadrant of the abdomen and gradually moves proximally toward the right upper quadrant while aligning the transducer in a transverse orientation to the colon until the area of intussuscep-

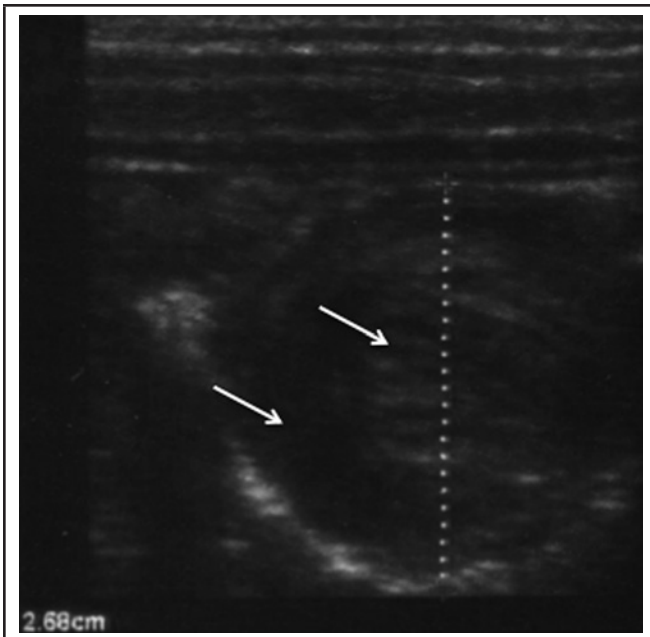


Figure 1. Transverse view through the right mid abdomen showing the target or bulls eye sign characteristic of intussusception, which is formed by a hypoechoic ring (between the two arrows) from the edematous walls of the intussusciens around an echo-dense center of the intussusceptum.

tion is encountered; this area sometimes presents as a palpable mass.^{6,10} On longitudinal view, the characteristic hayfork or sandwich sign is formed by three parallel hypoechoic areas separated by hyperechoic zones. These zones represent the dilated intussusciens containing the intussusceptum and is considered pathognomonic for intussusception.¹⁵ Alternatively, the appearance of a pseudokidney sign is formed if the intussusception is curved and when the mesentery is seen on only one side of the intussusceptum.¹⁶ The pseudokidney sign is most commonly seen on long-axis view.¹⁷ On axial view, there is a hypoechoic ring from the edematous walls of the intussusciens around an echo-dense center formed by the interfaces of the mucosal and serosal layers of the intussusceptum. This characteristic sign, which goes by several names including bulls eye sign, target sign, donut sign, or concentric ring sign, may also be seen in normal intestinal loops and with space-occupying lesions.¹⁶

With its characteristic appearance on ultrasound, the diagnosis of intussusception using ultrasound has been taught successfully to physicians and other healthcare providers after relatively brief teaching sessions. Since timely diagnosis and treatment is essential in preventing the complications of intussusception, such skills are invaluable to healthcare providers working on overnight hospital shifts, in remote community health centers, in third world countries, or in other situations where radiology services are not readily available. The value of teaching bedside ultrasound diagnosis of intussusception to local physicians and nurse practitioners in resource poor settings without access to

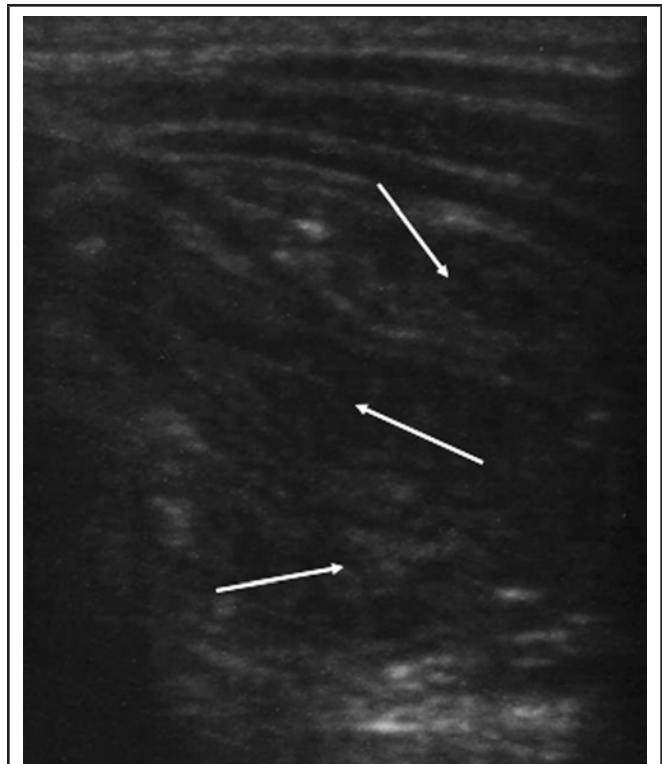


Figure 2. Longitudinal view showing the hayfork sign representing the apex of the intussusception. The hayfork sign is formed by three parallel hypoechoic areas (demonstrated by the three arrows) separated by hyperechoic zones, which represents the dilated intussusciens containing the intussusceptum, and is considered pathognomonic for intussusception.

radiology services has been recognized in several international case reports.^{18,19}

There has also been growing interest in bedside ultrasound training for pediatric emergency physicians and fellows due to the reported ease of use and high sensitivity in early learners. One study showed that six pediatric emergency medicine physicians who completed a one hour long course in bedside ultrasound were able to perform the exam with a sensitivity of 85%, specificity of 97%, positive predictive value of 85%, and negative predictive value of 97% for diagnosing intussusception.⁶ Another study found that a month long training course in bedside ultrasound examination enabled five pediatric emergency medicine physicians to perform bedside ultrasound with a similar positive predictive value for intussusception compared to ultrasound performed by trained gastroenterologists.²⁰ These studies show that different approaches can be used to teach novice learners how to diagnose intussusception with ultrasound. These approaches provide physicians the benefit of a rapid diagnosis, resulting in timely treatment and reduced length of stay in the ED—benefits that were also emphasized in this study as well as in other case reports of bedside ultrasound by emergency medicine physicians.²¹

Our case report illustrates that ultrasound applications may also be quickly taught to general pediatric residents working in the ED. Although pediatric ultrasound examinations may be taught in some pediatric residency programs, they are not part of the required curriculum in United States general pediatrics residency programs.²² Since 2010, University of Hawai'i pediatric residents have been taught bedside ultrasound skills during their residency while rotating in the pediatric ED. The focus during the second year of residency consists of didactic lectures, hands-on teaching with pediatric patients, understanding the layout of the ultrasound machine and the different transducers, and becoming familiar with the concepts of [ultrasound] frequency, depth, and gain effect. Simple bedside ultrasound exams such as bladder volume evaluation prior to urethral catheterization and abscesses and foreign body identification are taught by an RDMS certified pediatric emergency physician. During the third year of residency, pediatric residents are taught more advanced pediatric emergency bedside ultrasound applications such as evaluation of pneumothorax, hip effusion, hydronephrosis, abdominal pathology, and confirmation of successful intubation. Education in the use of bedside ultrasound may be a valuable experience for pediatric residents going into primary care, subspecialties, global health, or hospital medicine, as illustrated by our case report. There may be a growing role for ultrasound training within the medical education curriculum for all pediatric residents.

Conflict of Interest

None of the authors identify any conflict of interest.

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The Relationship of Decongestant Use and Risk of Decompression Sickness; A Case-Control Study of Hawaiian Scuba Divers

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Abstract

Exposure to cold, dehydration, and aging are known to contribute to the development of decompression sickness (DCS) in divers. Hypertension and nicotine usage have also been suggested as risk factors. Vasoconstriction is an underlying mechanism associated with all of these risk factors. Vasoconstriction increases the degree of bubble formation which is believed to be the cause of DCS. Formed bubbles interfere with the production of nitric oxide which modulates vascular tone resulting in vasoconstriction. Divers commonly use sympathomimetic decongestants which induce vasoconstriction to prevent barotrauma of the ears and sinuses while diving and thus theoretically may contribute to the risk for developing DCS. The purpose of this case-control study was to explore the association between decongestant usage and development of DCS in 400 divers treated/evaluated at the University of Hawai'i, John A. Burns School of Medicine between 1983 and 2010. Bivariate and logistic regression analyses were employed to evaluate differences between cases and controls. In addition to the variable of interest, other co-variables known to have significant influence in the development of DCS were appropriately controlled for during the analyses. In this study population, dehydration (OR=2.7; 95% CI: 1.1, 7.4), repetitive diving (OR=2.8; 95% CI: 1.8, 4.4), and violation of dive profiles (OR=4.9; 95% CI: 3.1, 7.9) contributed independently and significantly to the development of DCS. The co-variables of cold, gender, obesity, and rapid ascents were not significant contributors to developing DCS in this study. There was a small but statistically insignificant risk associated with decongestant use (OR=1.4; 95% CI: 0.8-2.6; P=.22). The inherent limitations associated with records-based studies may have underestimated this risk. It is important therefore that future research be undertaken to help clarify this concern.

Keywords

Decompression sickness, decongestants, epidemiology of diving accidents, diving health, safety

Introduction

Exposure to the underwater environment while diving with compressed gas incurs some risks. One of those risks is decompression sickness (DCS), which is believed to be caused by the formation of inert gas bubbles during decompression and is manifested by a broad array of symptoms which can result in severe morbidity, life-long disabilities, and even death.^{1,2} Thus there are profound public health implications associated with these injuries. The precise incidence of decompression sickness is unknown. Researchers at the Diver's Alert Network (DAN) at Duke University have demonstrated that the incidence rates for DCS have ranged from 1/10,000 to 1/20,000 dives with over 1,000 cases of DCS reported annually in the United States alone.³ In Hawai'i, the average yearly number of cases treated for decompression sickness is about 50 cases.⁴ Approximately 25% of these are classified as severe injuries resulting in significant residual morbidity.⁵ Epidemiological researchers have shown that cold exposure, as well as dehydration and aging,

increase the risk for developing DCS.⁶⁻¹⁰ Other epidemiological studies have also implicated hypertension and nicotine use from smoking as risk factors for developing DCS.¹¹⁻¹³ Koteng, et al, demonstrated that increased peripheral resistance resulting from vasoconstriction caused a greater degree of bubble formation during decompression.¹⁴ Each of these risk factors are associated with vasoconstriction which can alter the inert gas kinetics potentially leading to slower rates of off-gassing, increased bubble formation, and the development of DCS. Bubbles formed during decompression damage the endothelial lining of blood vessels and lower the production of nitric oxide which modulates vascular tone; in turn, the absence of nitric oxide results in vasoconstriction.¹⁵⁻¹⁸ The integrity and optimal functioning of the vasculature is a key factor in both on-gassing and off-gassing while diving.¹⁹ Several additional risk factors have been associated with the development of DCS including adiposity, gender, repetitive diving, violation of recommended depth and time limits (dive profile), and rapid ascent rates.^{1,2,8,9}

A second and more common affliction in divers is that of barotrauma to the ears and sinuses.²⁰⁻²² This results from poor equalization of the external water or ambient pressure with the internal pressures of the middle ear and sinus cavities. This occurs because of blockage of the ostia of the sinuses and/or the eustachian tubes of the ears, which normally provide ventilation to those air spaces.²³ Up to 65% of divers report this type of injury.²⁴ In order to prevent barotrauma, many divers use a sympathomimetic decongestant drug such as pseudoephedrine prior to diving. Researchers have found that 6% to 25% of divers routinely use these drugs while diving and another 30% occasionally use them.²⁵⁻²⁷ These drugs mimic the sympathetic nervous system by stimulating increased production of norepinephrine from nerve endings or by direct stimulation of vascular smooth muscle to induce vasoconstriction. Specifically, these decongestants stimulate alpha-adrenergic receptors embedded in the vascular smooth muscle and are referred to as alpha agonists.²⁸ However, their effects are not confined solely to those tissues for which they are targeted, but also produce systemic effects as well.²⁹ Westerveld, et al, demonstrated in an in vitro study of rat lung macrophages, that the nasal decongestants oxymetazoline and xylometazoline inhibited nitric oxide synthetase production, thereby reducing nitric oxide production.³⁰ As was previously mentioned, the absence or low levels of nitric oxide result in vasoconstriction.¹⁶

Lambertsen suggested that vasoactive medications might adversely impact the incidence of DCS.³¹ Thus, a hypothetical question ensues. Since vasoconstriction appears to be an

underlying mechanism associated with other established risk factors for DCS, could the use of sympathomimetic drugs while diving enhance the risk for developing DCS? The conventional thinking among diving medical experts is that it is probably safe to employ these drugs while diving.³² However, there is no scientific evidence to support this position despite these theoretical concerns. While these drugs have been studied to assess their effects on cognitive function and mental alertness while diving, no studies have been done to investigate their potential contribution to developing DCS.^{33,34} This study was undertaken to explore the possibility that use of sympathomimetic drugs during diving might increase the risk for DCS. Given the potential for long-term and sometimes catastrophic sequelae which may ensue from a case of DCS, there is a need to determine whether the use of these decongestants while diving poses additional risk for development of this malady. Data on this relationship will allow appropriate safety policies to follow regarding their usage while diving in an effort to lessen risk potential.

Methods

A records-based, case-control study of 400 scuba divers was undertaken to compare sympathomimetic decongestant usage in divers treated for DCS (cases) with those who did not exhibit signs or symptoms of DCS (controls) after diving. Cases and controls were drawn from a cohort population of over 1600 divers' records resulting from evaluation at the Hyperbaric Treatment Center (HTC) at the University of Hawai'i, John A. Burns School of Medicine between the years 1983 through 2010. The study population consisted of recreational divers. The same data had been collected from each patient relative to their immediate diving history irrespective of whether they were diagnosed with DCS or something else. This study was approved by the university institutional review board and human use committee.

The independent variable was decongestant use during an incident dive. Decongestants were defined as those medications which contained any of the following compounds: pseudoephedrine, oxymetazoline, phenylephrine, or xylometazoline.²⁹ Because most of these drugs are short acting, usually less than 12 hours, drug use during the incident dive was defined as usage within 12 hours prior to the documented incident dive. For this particular exploratory study, no distinction was made between topical usage versus oral administration of the sympathomimetic drug, and equivalency of dose and route of administration was assumed. The dependent variable was DCS.

The estimated sample size for this study was determined using Cohen's *d*. The effect size of .20 was selected based upon published studies of decongestant usage by divers which demonstrated that anywhere from 6% to 40% of divers may use these drugs.²⁵⁻²⁷ This effect size was a conservative estimate and led to a larger sample size requirement. By convention, an alpha level of .05 and power of .80 were utilized.

Cases were defined as those who were diagnosed and treated for DCS with records coded as 993.3 (ICD-9). Cases were restricted

to those who were 18 years and older, and had completed at least one dive immediately prior to presenting for evaluation. Sampled cases came from randomly selected calendar years until 200 cases were identified. The years selected were 1988, 1993, 1994, 1995, 1997, 2000, 2001, and 2007.

Controls were those divers, 18 years and older, who had completed at least one dive immediately prior to presenting for evaluation, and were diagnosed with a diving related problem other than DCS. Controls came from the same randomly sampled years as the cases. They were randomly selected and matched with replacement on a 1:1 basis to cases based on age +/- 5 years following a cumulative incidence sampling model.³⁵ This procedure effectively limited the risk for selection bias while ensuring representativeness of both cases and controls.

Specific information collected from each subject record was the ICD-9 code of the final diagnosis, age, gender, dive profile (depth and time length of dive[s]), history of rapid ascent, whether the diver made repetitive dives, temperature at admission or whether the diver complained of being cold during the incident dive, height and weight, whether the diver dehydrated as measured by a urine specific gravity of 1.025 or greater and/or receiving intravenous fluids, and whether the diver used decongestants during the incident dive(s).

Dive profiles were evaluated using the US Navy Diving Manual to determine whether the diver may have violated that profile³⁶. This approach was taken to standardize the assessment of the dive profile. Height and weight were used to determine BMI and if that value was greater than 30, the subject was classified as being obese. All collected data, aside from age and gender, were converted to either "yes" or "no" dichotomous nominal values for data entry into EpiInfo version 3.5.3 (Centers for Disease Control and Prevention Atlanta, Georgia).

The ultimate aim of this study was to compare the proportion of decongestant users in cases, to that in controls, to ascertain whether the odds ratio suggested a potential association between sympathomimetic drug usage and the occurrence of DCS. Since other confounding variables such as obesity, being cold during the dive, rapid ascents, repetitive diving, and violation of dive profiles also influence whether a diver develops DCS, these were analyzed as well. Initial analysis assessed the frequencies with which these variables were found in both the cases and the controls. Each was subjected to bivariate analysis to assess their independent impact within this study population. Odds ratios were determined. As this study analyzed proportions as well as nominal data, the level of significance was determined using chi-square or Fisher's Exact Test as required. Because the other co-variables may have played a role in combination with each other in the development of DCS, further analysis used logistic regression to determine the relative contribution of each co-variable in addition to the independent variable of this study.

Results

For the entire study population, the ages ranged from 18 to 66 years with a mean age of 35.9 years and a mode of 34 years.

There were 285 males (71.2%) and 115 females (28.8%). Sixty-nine (17.3%) had used decongestants. Violation of dive profiles occurred with 153 (38.3%) divers. Rapid ascents were identified in 111 (27.8%) divers. Two hundred sixty-three (65.8%) made repetitive dives. Only six (1.5%) were categorized as being cold; 74 (18.5%) were found to be obese, and 25 (6.3%) were classified as being dehydrated (Figure 1).

Bivariate Analysis

The average age for cases was 36.1 years with a mode of 34 years while the average age for controls was 35.7 years with a mode of 34 years. Contingency tables were employed to analyze bivariate relationships between the independent and confounding variables and DCS and the consolidated results are depicted in Table 1. Significant findings are shown in bold.

The bivariate analyses indicate that the co-variables of dehydration, repetitive diving, and profile violation resulted in odds ratios which were statistically significant (OR=2.7 95% CI: 1.1, 7.4; $P=.023$; OR=2.8 95% CI: 1.8, 4.4; $P=.000$; OR=4.9 95% CI: 3.1, 7.9; $P=.000$ respectively). The resulting odds ratios for the independent variable of decongestant use as well as the co-variables of cold, rapid ascent, and gender did not achieve statistical significance. To further assess these variables to investigate any interactions which may have influenced these findings, logistic regression was performed using all the variables at first and reducing their number until the appropriate final model was ascertained.

Logistic Regression

Logistic regression was carried out to assess the inter-relationships of the relative contribution and probabilities of each of the co-variables and the independent variable to the development of DCS in this study population. For this analysis, backward logistic regression was undertaken by initially entering all the co-variables and running repeated calculations after elimination of non-significant variables until the final model was arrived at which contained only variables with significance. The final model is shown in Table 2 which also includes the independent (study) variable of decongestant use for comparison.

The results of the logistic regression analysis indicate that dehydration, repetitive diving, and violation of dive profiles all contributed significantly to the development of DCS in this study population whereas the use of decongestants did not.

Discussion

Historically, the demographics and types, nature, and distribution of diving injuries seen at the HTC have mirrored those

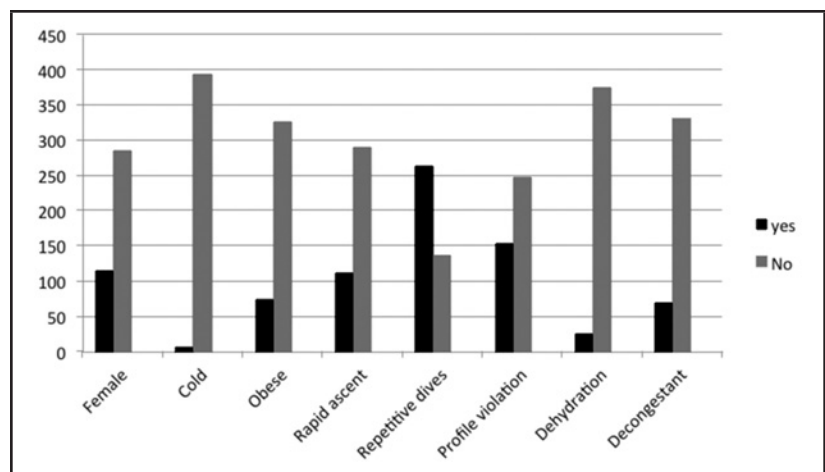


Figure 1. Frequencies of All Variables for Entire Study Population

Table 1. Results Bivariate Analyses Variables vs DCS

Variable	Odds Ratio	95% CI	χ^2	P-value
Gender	0.	0.6, 1.4	0.304	.581
Cold	5.1	0.6, 116.5	**	.212
Obese	0.7	0.4, 1.2	1.658	.198
Rapid Ascent	1.2	0.8, 1.9	0.609	.434
Repetitive Dives	2.8	1.8, 4.4	22.424	.000
Profile Violation	4.9	3.1, 7.9	53.223	.000
Dehydration	2.7	1.1, 7.4	5.149	.023
Decongestant Use	1.5	0.9, 2.6	2.113	.145

**Fisher's Exact Test

Table 2. Final Logistic Regression Model including Independent Variable (Decongestant Use)

Co-variable	OR	95% CI	Coefficient	SE	Z-statistic	P-value
Decongest Use	1.4	0.8, 2.6	0.36	0.30	1.21	.225
Dehydration	3.2	1.2, 8.5	1.17	0.50	2.35	.018
Repetitive Dives	2.4	1.5, 3.7	0.85	0.24	3.56	.000
Profile violation	4.3	2.7, 6.7	1.45	0.23	6.22	.000

reported throughout the country.⁴ The total study population of 400 was comprised of 28.8% females and 71.2% males. This distribution of study subjects is consistent with the percentages of certified scuba divers based upon gender within the general diving population.³⁷ No statistical differences were identified during the analysis of this data for any of the variables based upon gender. The average age for subjects who developed DCS was nearly identical to that of the non-DCS controls because of age matching, thus there is no concern that age differences may have influenced the outcomes.

The findings for this case-control study indicate that only dehydration, repetitive diving, and violation of dive profiles were statistically significant contributors for the development of DCS. This was established in both the bivariate and multivariate

analyses of the variables. These findings do not imply that those variables other than the independent variable of decongestant use, which have been previously established as risk factors, are not of import to developing DCS, but rather indicate that in this particular study population, they did not play a significant role. With respect to the variable of interest, decongestant usage, it was shown that 17.3% of the studied divers used these medications. This was slightly less than the expected 20% usage used to calculate the sample size for this study. It is unlikely that increasing the sample size for this study would have appreciably affected the overall percentage of divers who used decongestants. There were significant limitations in this study which may have influenced the outcome. Records-based studies are dependent upon the quality and thoroughness of the records.³⁸ This cohort was amassed over a time period of 27 years during which time there were multiple evaluators who documented their findings in the records and the quality of the efforts to solicit all the patient information may not have been uniformly comprehensive. A lack of notation in the records of the use of decongestants was interpreted in this study as non-use so as to avoid overestimation. It is possible however that some of those undocumented subjects had actually used these drugs which would lead to underestimation of the actual use and risk and in turn would favor the null hypothesis of this study and represents possible information bias.³⁹

Berkson's bias, or hospital admission bias, must also be considered.³⁹ This situation extends from the fact that clinic records were used for this study for both cases and controls. It invites the question of representativeness of the sampling of the study population. With respect to cases, the vast majority of divers with DCS in Hawai'i who develop DCS are treated at the HTC which is the only facility other than the US Navy which treats these injuries. So for cases of DCS, the data is assumed to be representative of the diving population; this is further suggested by the comparability of HTC's DCS data to national trends for such injuries.⁴ For controls however, Berkson's bias may be in play. Certainly it could be argued that those who served as controls were different than those in the general diving population in Hawai'i. Because this was a retrospective study, it would have been impossible to obtain the specific, reliable data needed to conduct this study dating back to 1983 without very significant recall bias. To mitigate Berkson's bias, controls were randomly chosen from the same randomly chosen years from which the cases were drawn. This also aided in ensuring that trends in sympathomimetic decongestant usage over the time span of this study would be similar in both cases and controls.

This study also made no attempt to distinguish between topical agents or those taken orally. Additionally, no effort was made to assess the specific dosages of the medications which were used or the specific timing of the administration of the drug within a 12 hour window prior to diving. Conceivably, any or all of these considerations might have a bearing on the outcome. However, this approach allowed for the opportunity to take an initial broad look utilizing the greatest number of

exposures to determine whether the hypothesis had merit. Had this exploratory study demonstrated that use of sympathomimetic decongestants while diving did increase the risk for developing DCS, a more focused analysis looking at those additional parameters would be warranted.

Conclusions

Given the sample size and power of this study, it is reasonable to conclude that the use of sympathomimetic decongestants did not increase the risk for developing DCS whereas dehydration, repetitive dives, and violation of dive profiles were shown to significantly contribute to the development of DCS. The inherent limitations associated with records-based studies may have biased the outcome and underestimated the risk associated with decongestant usage while diving in this study. It is important, therefore, that future research be undertaken to further clarify this concern.

Conflict of Interest

The author identifies no conflict of interest.

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MEDICAL SCHOOL HOTLINE

Celebrating 40 years of 'Imi Ho'ōla

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The Medical School Hotline is a monthly column from the John A. Burns School of Medicine and is edited by Satoru Izutsu PhD; HJMPH Contributing Editor. Dr. Izutsu is the vice-dean of the University of Hawai'i John A. Burns School of Medicine and has been the Medical School Hotline editor since 1993.

JABSOM's Commitment to Student Diversity

The John A. Burns School of Medicine (JABSOM) was established in 1967 as a 2-year pre-clinical program, requiring students to complete their last two clinical years of medical education on the continental United States. Six years later, JABSOM became a 4-year medical degree granting institution and established itself as the first and only US accredited medical school in the Pacific basin. JABSOM's longstanding commitment to student diversity, particularly Native Hawaiian and Pacific Islander representation in medicine, began with its first Dean, Dr. Windsor Cutting. Dr. Cutting's vision produced the Dean's Guest program which later became *Kulia* (Hawaiian meaning for "to strive").¹ The Dean's Guest and *Kulia* programs offered faculty tutoring to disadvantaged students primarily from the Pacific and an additional year to complete the 2-year preclinical medical program. Students who excelled in the Dean's guest program were presented to the executive committee with recommendations to advance as a full time medical student. Historically, these programs set the foundation necessary to garner support to create the highly successful educational model now known as the 'Imi Ho'ōla Post-Baccalaureate Program. The 'Imi Ho'ōla program is institutionalized within JABSOM and is part of the Department of Native Hawaiian Health.² This article describes the evolution of 'Imi Ho'ōla, its current educational curriculum, community partnerships and supporters, the program's 40th anniversary celebration, and alumni outcomes.

Evolution of 'Imi Ho'ōla

In 1973, the 'Imi Ho'ōla (Hawaiian meaning for "those who seek to heal") Program was formed under the leadership of Dr. Benjamin Young. 'Imi Ho'ōla was originally created to increase Pacific Islander and Native Hawaiian representation in medical school by increasing their competitiveness to successfully gain admission and graduate from JABSOM. The program's mission continues to focus on improving health care for Hawai'i and the Pacific by increasing the number of physicians through a one year enrichment program. An Advisory Committee, comprised of community leaders in education, medicine, and business was established to review prospective candidates, conduct interviews and select students for the program. In the first two decades of the program's history (1973-1994), 'Imi Ho'ōla focused on premedical enrichment for students preparing to

apply to medical school. Up to 25 students were accepted into each class and upon completion, students would competitively apply for entrance into JABSOM.

Beginning with the 1996-1997 class, 'Imi Ho'ōla underwent a significant organizational transformation and became a post-baccalaureate program due to federal funding priorities. The transformation was overseen by immediate past Director, Dr. Nanette Judd. The program would now accept up to 10 students each year and once enrolled in the program, students gained a conditional acceptance to JABSOM. In 2010, JABSOM's Dean Jerris Hedges increased the 'Imi Ho'ōla enrollment to 12 students per class. Students from economically, socially, and/or educationally disadvantaged backgrounds who possess the potential to succeed in medicine are eligible to apply.³ A Community Advisory Board continues to guide the program in selecting the most qualified candidates for the program. Once students meet *Kama'aina* (having state of Hawai'i ties), academic, and disadvantaged screening requirements, they are reviewed by the Advisory Board members and selected for consideration. Students are prioritized based on their academic and professional potential as well as their commitment to serve in underserved communities of Hawai'i and the Pacific. The recommendations made by the Advisory Board are then forwarded to the JABSOM Admissions Committee who makes the final selection of the students who gain entrance to the 'Imi Ho'ōla Post-Baccalaureate Program. Upon successful completion of the program, students matriculate into JABSOM as first year medical students.

Current Educational Curriculum

'Imi Ho'ōla's curriculum and teaching philosophy is student-centered, supporting an individual student's academic and professional development. The current curriculum emphasizes the integration of concepts in the sciences and humanities and further develops students' communication, critical thinking, and learning skills. Students complete a series of assessments that are used to determine the students' current level of learning skills development and approach to mastering new information. The information obtained by the learning assessments are analyzed and used to create an individualized educational plan for each student. This comprehensive educational plan is used throughout the year to provide feedback and develop strategies

for each student to achieve success in the program. The program faculty meets with each student six (6) times throughout the year. During these student conferences, students receive formal feedback regarding their performance in the program. Feedback regarding students' professional behaviors is also incorporated into the educational plan.

Each semester, students are enrolled in 3 core courses — Medical Biology, Medical Biochemistry, and the Scientific Basis of Medicine. Medical Biology and Medical Biochemistry develop the students' knowledge and understanding of the basic sciences while enhancing their problem solving and critical thinking skills. The Scientific Basis of Medicine Course introduces students to a global view of health and disease and provides a forum to discuss the epidemiological and psychosocial aspects of disease on a local, national, and international level. Classes are taught using the problem-based learning method (small group, student-driven, and tutor facilitated learning process) and didactic lectures. Students also gain team building and leadership skills through experiential learning opportunities such as the Kalaupapa Service Learning project and physician shadowing in rural and underserved communities of Hawai'i.

Community Partnerships and Supporters

'Imi Ho'ōla's success is made possible through the ongoing support of community partners and contributors to the program. Since 2002, the Queen's Health System has directly contributed funding for 'Imi Ho'ōla student stipends. Students receive a monthly stipend that helps defray the cost of tuition, books, and living expenses. This generous and vital financial support allows students to focus on their studies and is critical to their successful completion of the program.

In 1999, the Friends of 'Imi Ho'ōla was established as a non-profit 501(c)(3) organization. The Friends of 'Imi Ho'ōla began as a grassroots effort to provide on-going support for students in the program. It became apparent to program alumni and faculty that mentoring students was an important component to sustaining student motivation and inspiration to succeed in the rigorous program. The group's purpose is to provide support and independent funding to assist the 'Imi Ho'ōla program and its students in carrying out their goals and activities. Dr. Dee-Ann Carpenter, 'Imi alumna and founding President, is still part of the Board of Directors today. Friends of 'Imi continues to grow and support the program with financial support, time, and energy. Since its inception, the funding from Friends of 'Imi has supported students' educational materials and the annual 'Imi Ho'ōla completion ceremony. With donations from alumni, friends, and community supporters, Friends of 'Imi Ho'ōla created the Friends of 'Imi Ho'ōla Tuition Assistance Award (FIHTA) in 2010. Friends of 'Imi Ho'ōla continues this tradition each year and has awarded \$27,000 in FIHTA support. Also, individual donors, through the University of Hawai'i Foundation, support student and program activities throughout the year.

40th Anniversary Celebration

The 'Imi Ho'ōla 40th anniversary celebration was held on July 26, 2013. The evening speakers included the Honorable Judge James Burns who eloquently described how the 'Imi Ho'ōla program continues to keep the dream of his father, the late Governor of Hawai'i, John A. Burns, alive by providing opportunities in higher education for Native Hawaiians and other Pacific Islanders. Dean Jerris Hedges and former program leaders Drs. Ben Young and Nanette Judd also contributed to the celebration by reflecting on the impact that 'Imi Ho'ōla has had on the medical school and the community. The event also honored Dr. Rahki Ram (Dean's guest and JABSOM alumnus) and his wife MaryAnn for their outstanding philanthropy in establishing the Tarsavi Wati and Ishwar Dass 'Imi Ho'ōla Program Endowment. Support from the endowment will benefit current 'Imi Ho'ōla students as well as graduates of the program. A highlight of the evening took place when Dr. Amy Agbayani presented the program with a formal recognition and announcement from Governor Abercrombie proclaiming July 26, 2013 as 'Imi Ho'ōla day.

Alumni Outcomes

To date, 234 'Imi Ho'ōla alumni have successfully graduated from JABSOM. Of these graduates, 38% are Native Hawaiian, 24% are Filipino, and 18% are other Pacific Islanders (ie, Samoan, Palauan, Marshallese, Yapese, Pohnpeian, Kosraen). Of the 234 'Imi Ho'ōla graduates, 85% are providing primary care services and at least 80% of the physicians are practicing medicine in underserved communities where they are needed most. As the 'Imi Ho'ōla Post-Baccalaureate Program celebrates its 40th Anniversary, we look positively to the future as 'Imi Ho'ōla continues to produce physicians and health care leaders that impact the health of our patients, families, and communities.

Acknowledgement

Dr. Nanette Judd, former Director of the 'Imi Ho'ōla Program, for her contributions to this article

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INSIGHTS IN PUBLIC HEALTH

The Hawai'i-China Public Health Partnership

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Insights in Public Health is a monthly solicited column from the public health community and is coordinated by HJMPH Associate Editors Jay Maddock PhD from the Office of Public Health Studies at John A Burns School of Medicine and Donald Hayes MD, MPH from the Hawai'i Department of Health in collaboration with HJMPH Manuscript Editors Tonya Lowery St. John MPH and Ranjani Starr MPH from the Hawai'i Department of Health.

There is growing recognition that global health is public health.¹ Over the past decade there has been a shift from international health where high income countries provide aid to low income countries to global health where interdependence and collaboration between countries is embraced.¹ To address our changing world, there is an apparent need to change the way that health professional students are trained. This involves among other things providing global opportunities and having public health faculty who are well-versed in global health issues.

China accounts for almost one fifth of the world's population.² Over the past 30 years, the country has gone through a period of rapid modernization and westernization. While this has had positive effects on the population including creating a large middle class and lifting millions of people out of dire poverty, these changes have also been linked with numerous negative consequences related to public health.

Air pollution levels in many cities in China have been dangerously unsafe. The Air Quality Index (AQI) is used to measure the amount of particulate matter in the air.³ A level exceeding 150 is considered unhealthy for all people.³ Over the past year, several cities have reported an AQI of over 400 and this has been linked to increased mortality in men.^{4,5} The large pressure to make profit at all costs, rapid industrialization, limited knowledge, and lack of ethical responsibility has affected the safety of products brought to the market for sale.⁶ There have been several incidences of unsafe meat and other food products.⁷ Of particular concern is the tainting of baby formula with melamine.⁸ This has caused deaths in infants throughout the country and caused fear in populations. Health behaviors are also changing rapidly. Tobacco use and binge drinking among males is extremely high and is an expected part of the business culture.^{9,10} The rate of childhood obesity has been increasing rapidly throughout the country over the past 30 years.¹¹ Like in the United States, the reasons for these increases are multifactorial but related to less physical activity and higher calorie consumption. For instance, in Beijing, the number of cars registered in the city increased from 1,000,000 in 1997 to 4,000,000 by 2009.¹² Western fast food chains are also making large in-roads into China. Yum Brands' corporate website indicates that they now have over 6,000 restaurants in

China and are opening more than 1 a day with a goal of having 20,000 restaurants in the country before market saturation is reached.¹³ This large increase in fast food restaurants is changing eating patterns, especially among young people in China today. Additionally, the threat of infectious disease transmission including avian influenza remains a constant concern. The sheer size of the population in China coupled with the rapid changes happening in the nation make it an essential learning component for any American public health professional.

In 2007, the University of Hawai'i at Manoa Office of Public Health Studies, sent their first delegation of public health faculty to China to assess the potential for partnering with Schools of Public Health in the country. The delegation was warmly received by the Schools of Public Health at both Wuhan and Fudan Universities. Fudan University, located in Shanghai was founded in 1905. The School of Public Health is quite large with a faculty of around 140 and is typically ranked at the very top among the schools of public health in the country. Wuhan University, located in central China in the city of Wuhan, was founded in 1893 and typically ranks among the top 10 universities in the country. However, the School of Public Health was small and new at the time, having been only founded in 2001. Exchange agreements were signed with both universities. These agreements provided a mechanism for faculty and students to go to each other's universities. In May-June every year, students from the University of Hawai'i go to China. They spend one to one and half months studying and working there. Students are exposed to numerous public health programs in the community and visit hospitals, community health care centers, centers for disease control, and research institutes. Hawai'i students are also paired with Chinese students to expose them to the lifestyle and culture of young people in China. Over the past 7 years, more than 20 University of Hawai'i at Manoa students have participated in the exchange program. Several research projects have occurred including one examining the ecological impact of the Three Gorges Dam.¹⁴ In July every year, students from China come to Hawai'i. Over the past seven years, we have hosted over 40 students. Most of these students have never left China prior to this trip. During their stay, they visit the Hawai'i State Department of Health (DOH), the DOH state lab, a wastewater

treatment plant, and a local community health center. During the rest of their visit, they work in the laboratories of Office of Public Health Studies (OPHS) faculty members. Students from both countries have found the exchange program to be eye-opening and a life-changing experience. Also, each year OPHS faculty are also sent to China to teach during the May-June timeframe. The faculty teach a special course in their area of expertise often with 30-600 students in the class. Of the 20 current teaching faculty at OPHS, 12 (60%) have participated in the exchange. This has enriched the OPHS curriculum with a global perspective that enables faculty to discuss the current public health situation in China from a first-hand standpoint.

Over the past seven years, our partnerships have continued to evolve. In 2013, we signed an exchange agreement with Nanchang University. Nanchang is the capitol city of the Jiangxi Province and the largest university in the province with over 60,000 students. The Jiangxi Province has historically had one of the lowest per capita incomes in the country; however, the area is rapidly modernizing and the growth rate is one of the highest in China. Using what we learned in the earlier exchanges, Nanchang University was able to establish research start-up funds. These funds allowed us to conduct two research studies on caretakers of youth aged 2-10 years old, examining the perceptions of air quality on their children's health, and the effect of the parenting and home environment on obesity. Four papers have been written and submitted from last year's data collection as well as several conference presentations with both Chinese and Hawai'i students serving as the lead authors. In Wuhan, we have signed our second five-year agreement. This agreement has included several achievements including OPHS assisting Wuhan University in hosting the largest public health conference in Asia, the Asia-Pacific Academic Consortium for Public Health, as well as becoming a partner in the new Global Health Institute. In October 2013, Wuhan University and University of Hawai'i at Manoa (UHM) signed an articulation agreement to facilitate students completing their undergraduate degree at Wuhan and their Masters at the University of Hawai'i. We are currently in the process of renewing our agreement with Fudan University.

In conclusion, the Hawai'i-China Public Health Partnership has been a tremendous success. It has fostered collaboration and friendship between two nations that are having some political difficulties. It has helped students and faculty from both sides gain a better understanding of the important public health infrastructures in two of the world's most powerful countries. We look forward to many more years of exciting and innovative collaboration.

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THE FEDS GIVETH. THE FEDS TAKETH AWAY.

In a silly confrontation of government bureaus, the Federal Communication Commission (FCC) voted 3 to 2 in favor of advancing a proposal to overturn a 22-year-old ban on cell phone use during flights. At almost the same time the Department of Transportation issued a surprise announcement stating it believes the airline industry and the flying public are overwhelmingly against such cellphone use. The FCC was only determining whether it was technically feasible to use cellphones during flight. The five commissioners expressed personal reservations about in-flight calls. Chairman Thomas Wheeler was “very heartened” when Transportation Secretary Anthony Foxx announced the DOT will consider banning in-flight voice calls. Foxx said his department has heard from airlines, fliers, flight attendants, lawmakers, and others who are “troubled” over the idea of passengers talking on cellphones during flight. If push comes to shove, the Transportation Department’s decision will prevail. Who says big government doesn’t work?

CAMELS 100TH ANNIVERSARY BIRTHDAY PARADE SHOULD BE LED BY THE GRIM REAPER.

R.J. Reynolds Company is planning to celebrate the 100th anniversary of the modern cigarette. In October 1913 Camel cigarettes debuted in the United States introducing a new tobacco blend that was “mild enough to be inhaled and sweet from sugars add to the mix.” Sold in neatly packaged boxes of 20, Camels proved to be wildly popular with 42.5 million sold in 1914 and 6.5 billion just two years later. At its sales peak Camel sold an astounding 105 billion cigarettes in 1952. The last 50 years have seen Camel sales drop by half in America as people began to recognize the down side of tobacco. Sales remain robust in Mexico and Europe where Camel will push their party favors. In summary, R.J. Reynolds will be celebrating 100 years of generating cancer, heart disease, COPD, emphysema and pulmonary fibrosis, not to mention house and clothing fires and bad breath.

SURPRISE! THE TICK IS TOP OF THE CHARTS AS A DISEASE VECTOR IN THE UNITED STATES.

In the mid 1970s a cluster of school children in Lyme, Connecticut, developed body aches and fever. Doctors thought they had juvenile arthritis, a very unlikely diagnosis for so many children in one place. Ultimately, Allan Steere, a physician at Yale University, found that they all suffered from an infection. The cause of the disease remained mysterious until 1982 when Willy Burgdorfer, an entomologist with the National Institute of Allergy and Infectious Diseases, discovered the sneaky spirochete in black-legged ticks from Long Island. It was named *Borrelia burgdorferi* after the sharp-eyed scientist. Because the infection first became notorious in the town of Lyme, it was quickly labeled Lyme Disease. New York and other northeast states, reported new infections in the 1980’s. Lyme disease was noted around the same time in Wisconsin and radiated west as far as California and south to Virginia. Each year 38,000 cases are diagnosed. Symptoms include fever, aches, and fatigue, and if left untreated for a length of time, arthritis, cardiac arrhythmia and neurologic damage may ensue. Look for the red bulls-eye around the site of the bite, and be ready with antibiotics.

SOME STAY HIGH-FALOOTIN’ BY AVOIDIN’ GLUTEN.

About two to three million Americans suffer from celiac disease. This auto-immune condition renders the digestion and absorption of nutrients very difficult in the presence of gluten, a protein that is found in wheat, barley, and rye. The National Foundation for Celiac Awareness estimates that another 18 million have gluten sensitivity, meaning they experience diarrhea, anemia and other symptoms, but

lack antibodies and evidence of intestinal damage. Millions more who don’t have a specific health issue are eliminating gluten from their diets, and believe they feel better. This dietary phenomenon has become a headache for restaurant chains as they struggle to produce dishes that meet the strict requirements of government regulators and customers to be “gluten-free.” California Pizza Kitchen pulled pizzas off the menu and spent more than a year training employees. Noodles & Co. recently began offering gluten-free noodles that can be used with any dish. Olive Garden offers a gluten-free menu on request, but makes “no guarantee regarding the gluten content of these items.” Without trying, 1% of the population with real disease has created a food fad to upset the food industry. It’s peanut allergy all over again. Baa...

WE AIM TO PLEASE! YOU AIM TOO, PLEASE.

Comedienne Rita Rudner has a line about men going to the bathroom only “need to hit something.” In Britain, physicists seriously undertook to study the “splashback” of male urine. A standing man sends a stream about 5 or 6 times the length of a sitting person, easily reaching seat and floor. Even without factoring in the Plateau-Rayleigh Instability — the inevitable disintegration of a liquid stream 6 or 7 inches from its formation — some ricochet is sure to occur. Speaking at a November conference, the researchers recommend standing slightly to one side, and lowering the angle of impact. Right.

DO SQUIRRELS ATTACK WHEN THREATENED?

Tennessee police officer Jody Putnam was inside a crowded convenience store when employees spotted a squirrel. Officer Putnam fired his gun at the rodent, but missed. Next he tried to spray the critter with mace, but that failed as well. Coughing customers quickly vacated the store. Owner Carl Duffield said it was comical, but customers were not amused. For his overly aggressive attempt to bring the squirrel to justice, Officer Putnam was dismissed. Some days it just doesn’t pay to get out of bed.

AT THIS LASER CENTER THEY WILL KEEP AN EYE OUT FOR YOU.

In the cosmetic world of attracting attention, at New York City’s Park Avenue Laser Vision, patient Lucy Luckayanko had a \$3,000 platinum jewel placed between the sclera and conjunctiva of her eyeball. The report did not state which eyeball, but possibly one could tell upon meeting Lucy, otherwise she wasted 3 grand plus. The surgical fee was not revealed, and did the surgeon warn her that the jewel might migrate posteriorly out of view?

ADDENDA

- Ads for Super Bowl XLVIII sold out in early December 2013. Cost is \$4 million for 30 seconds.
- Hawai’i at 16.2 years has the longest life expectancy after age 65 according to the CDC. Mississippi is the shortest at 10.2 years.
- One in every 275 women ages 20 to 54 in America has had breast augmentation.
- From larva to fully engorged adult, a female tick will grow to 2,880 times its original size. Try to imagine a human infant ballooning to the size of a humpback whale.
- The first hand-held mobile phone is now 40 years old. It weighs 2 pounds.
- My nephew tried phone sex and got an ear infection.
- This creepy Oscar Meyer guy is inventing meat. There is no olive-loaf animal as far as I know.

ALOHA AND KEEP THE FAITH rts

(Editorial comment is strictly that of the writer.)

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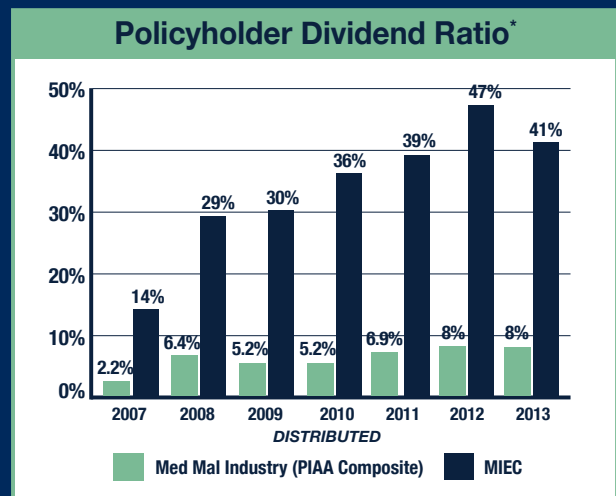


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