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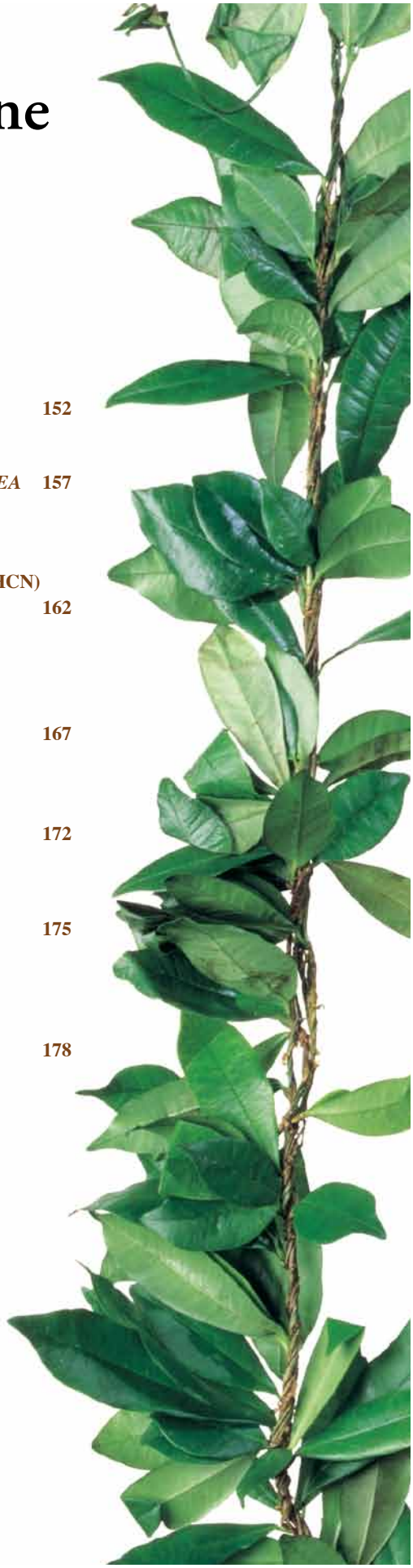

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A Review of Femtosecond Laser Assisted Cataract Surgery for Hawai'i

Ming Chen MD, MSc, FACS

Abstract

Hawai'i has had the first US Food and Drug Administration approved femtosecond laser (LenSx as shown in figure) for cataract surgery since early 2012, a brand new laser technology for modern cataract surgery in Hawai'i. This article intends to evaluate the cost, safety, efficacy, advantages, and limitations of femtosecond laser-assisted cataract surgery through a review of the literature for the public of Hawai'i. A search was conducted using keywords to screen and select articles from PubMed. In addition, recent published peer reviewed articles pertinent to the femtosecond laser-assisted cataract surgery were selected and reviewed. Safety and efficacy of femtosecond laser-assisted cataract surgery were demonstrated in the literature, with improvements in anterior capsulotomy, phacofragmentation, and corneal incision. However, there were limitations within these studies which included small sample size and short-term follow-up. In addition, cost-benefit analysis has not yet been addressed. Long-term studies to compare the complication rate and visual outcome between the laser and conventional cataract surgery are warranted.

Keywords

Capsulorhexis, Capsulotomy, Cataract, Cataract Laser Extraction, Clear Corneal Incision, Femtosecond, Femtosecond-Assisted cataract surgery, Fragmentation, Laser, LenSx, OptiMedica, LensAR, Optical Coherence Tomography, Phacoemulsification, Phacofragmentation, Refractive Cataract Surgery

Introduction

Lasers have been utilized in cataract surgery since the 1970s, when Krasnov reported a laser modality for phacopuncture.[1] Subsequently, in 1987, Peyman and Katoh focused an Erbium: YAG laser on the lens nucleus, inducing photoablation.[2] Currently, there are three lasers; OptiMedica (Santa Clara, CA), LenSx (recently acquired by Alcon, Fort Worth, TX), and LensAR (Winter Park, FL) that have studies in the literature for review. LenSx is the laser available in Hawai'i. The birth of LenSx laser cataract surgery can be dated to 2009, when Zoltan Z. Nagy, MD, of Semmelweis University in Budapest, evaluated and described the ability of the LenSx femtosecond laser system (LenSx Lasers Inc, and Alcon Laboratories Inc) to perform anterior capsulotomy, lens fragmentation and to create self-sealing corneal incisions.[3,4] Today, over 61,000 procedures have been performed with this laser and over 300 units are available worldwide. Since premium intraocular lenses (IOLs) are getting more popular for near perfect vision, methods to increase accuracy and precision in cataract surgery are being investigated.[5-7] Femtosecond Laser assisted cataract surgery (FLACS) may be the answer to the investigation. Although FLACS can be a promising surgical modality, there are questions of its widespread utility and accessibility.

The laser system of LenSx is an all-solid-state laser source that produces a kHz pulse train of femtosecond pulses. An optical coherence tomography (OCT) imaging device and a video camera microscope (VM) are used to localize specific targets and to view the patient's eye. Its intended uses in cataract surgery include anterior capsulotomy, phacofragmentation and creation of single plane and multi-plane arc cuts/incisions in the cornea, each of which may be performed either individually or consecutively during the same procedure. The LenSx Laser focuses a beam of low energy pulses of infrared light into the eye. Each pulse of energy creates photodisruption of a microvolume of tissue at the focus of the beam. When scanned, the beam places individual photodisruption sites in a contiguous pattern to form continuous incisions. A typical incision consists of several tens of thousands micro-disruptions. By programming the size, shape and location of the scanning pattern, incisions are created. An anterior capsulotomy incision consists of a cylindrical cut starting from below the surface of the anterior capsule and continuing through the capsule a few microns into the anterior chamber. A lens phacofragmentation incision consists of two or more vertically oriented elliptical- shaped planes that intersect at the center of the lens.[1,2] This article intends to evaluate the safety, efficacy, advantages and limitations of femtosecond laser-assisted cataract surgery through a review of the literature.

Method

A PubMed electronic search in September 2012 was conducted using the following key words: Capsulorhexis, Capsulotomy, Cataract, Cataract Laser Extraction, Clear Corneal Incision, Femtosecond, Femtosecond-Assisted cataract surgery, Fragmentation, Laser, LenSx, OptiMedica, LensAR, Optical Coherence Tomography, Phacoemulsification, Phacofragmentation, Refractive Cataract Surgery.

Inclusion criteria for this search:

- All peer reviewed published articles or abstracts in the program of major ophthalmological meetings that investigated and demonstrated the benefits and limitations of femtosecond laser assisted cataract surgery.

The exclusion criteria:

- Studies were not pertinent on the topic of the benefit and limitation of femtosecond assisted cataract surgery.

Twenty eight papers were selected from one hundred forty five search results using the key words and those results were reviewed as following.

Results

Palanker, et al, studied 59 eyes of 50 patients who underwent FLACS using the OptiMedica platform in one eye, with the other eye receiving traditional cataract surgery. Postoperatively, 38% of laser treated eyes compared to 70% of eyes subjected to traditional cataract surgery experienced corneal edema. Best

corrected visual acuity (BCVA) showed a gain of 4.3±3.8 lines in the laser group eyes (n=29) and a gain of 3.5±2.1 lines in the traditional group eyes (n=30). The authors also tested 12 rabbit eyes to assess retinal safety using maximal laser settings of 6 μJ and 100 kHz. With fluorescein angiography and fundoscopic imaging at 1 hour, and then at 3 days, they observed no retinal or other damage.[8]

Slade described 50 eyes treated with LenSx, and showed the corneal incisions self-sealed were reproducible and architecturally sound. The author showed less induced coma and astigmatism, manipulation, and phacoemulsification time. There was also less variation in lens position. He reported 100% of eyes achieved 20/30 or better BCVA after one week.[9]

However, Edwards, et al, performed a study with conventional versus LensAR FLACS, which included 60 FSL (Femtosecond laser)-treated eyes and 45 conventionally treated eyes. There were no significant differences in the outcomes of BCVA, IOP (intraocular pressure), or corneal thickness between the two groups. No major complications were reported in either group.[10]

The clear corneal incision (CCI) has been associated with an increased risk of postoperative endophthalmitis.[11] A recent study utilized anterior segment OCT after cataract surgery to show that a majority of eyes had an internally gaping corneal wound and detachment of Descemet's membrane after CCI.[12] It is hypothesized that these detected wounds can increase the risk of postoperative endophthalmitis. FSL may allow for more square architecture, which has proven more resistant to leakage.[13] Masket, et al, conducted a cadaver eye study in which they showed decreased leakage, added stability, and reproducibility at various IOPs after FSL-guided corneal incision.[14] Additionally, Palanker, et al, observed they could create an incision using the FSL that formed a one-way, self-sealing, and water-tight valve under normal IOP.[8] Nevertheless, currently no published comparative studies on endophthalmitis between standard keratome and FSL-guided incisions are available.

FSL systems are capable of delivering cuts to precise depths and lengths on cornea without touching the epithelium for limbal relaxation incision (LRI) and these LRIs may be more accurate, safe and adjustable when compared to manual techniques.

Trivedi, et al, demonstrated that smooth, regular edges may offer superior capsular strength and resistance to capsular tears.[15] In addition; the unpredictable diameter observed in manual capsulorhexis can have effects on IOL centration, with subsequent poor refractive outcomes, unpredictable anterior chamber depths, and increased rates of posterior capsular opacification.[16-18] The FSL is able to deliver a more circular, precisely planned capsulorhexis. Nagy, et al, performed anterior capsulotomies in 54 eyes, comparing the LenSx laser to manual capsulorhexis 1 week after cataract surgery. In the FSL group, the authors observed a higher degree of circularity, fewer patients with incomplete capsulorhexis-IOL overlap (11% of laser patients compared to 28% of manual capsulorhexis patients), and better IOL centration. Using the OptiMedica FSL platform, two studies similarly demonstrated a statistical advantage for the FSL-assisted capsulotomy in terms of precision, accuracy, and reproducibility in human eyes.[8,19] Kránitz, et al, studied the LenSx platform and compared manual capsulorhexis to FSL-assisted capsulorhexis with 1 year of follow-up. The authors observed greater capsulorhexis-IOL overlap in the FSL group and greater amounts of horizontal IOL decentration in the manual capsulorhexis group. This study suggested that decentration of the IOL was six times more likely to occur in the setting of manual capsulorhexis.[20] Friedman, et al, and Nagy, et al, showed greater strength in FSL-guided capsulotomies in porcine eyes.[19,21]

Early studies have shown that FSL systems reduced ultrasound energy necessary for all grades of cataract.[22,23] Nagy, et al, showed that the FSL reduced phacoemulsification power by 43% and operative time by 51% in a porcine eye study.[21] Two studies have compared human eyes receiving FSL-assisted capsulorhexis and phacofragmentation to fellow eyes receiving traditional cataract surgery. Both show easier phacoemulsification in the FSL group.[8,23] In one of these studies, Palanker, et al, observed a decrease in the perceived hardness of nuclear sclerotic cataract after the laser-assisted procedure, estimated by the surgeon to decrease from grade four to grade two. A 39% average reduction in dispersed energy for phacoemulsification was also observed in the FSL group.[8] Furthermore, Uy showed that with grade three or higher cataracts, FSL-assisted lens fragmentation also reduced the amount of energy.[24] Ultrasound phacoemulsification carries the risk of corneal injury. Using rabbit eyes, Murano, et al, studied the effect of ultrasound oscillations in the anterior chamber. The authors observed oxidative stress and cellular necrosis after ultrasound, and concluded that the corneal endothelial cell damage was caused by free radicals.[25] Similarly, Shin, et al, showed that increasing ultrasound time and energy had a direct relationship to cell injury.[26] With consideration to a reduction in ultrasound energy and instrumentation, FSLs may show improved safety and decreased complications. A more recent study also demonstrated that IOL power calculations were more predictable with laser assisted cataract surgery.[27]

Figure: Photo of LenSx

Table 1. Current Evidences on Benefits of Laser Assisted Cataract Surgery to Reduce Complication from Phacoemulsification	
Benefits	**Reasons**
Less Cornea edema and less damage to eye	Less phaco time, less damage to endothelium
Better Wound healing	More precise wound, more square wound
Better capsulorhexis	Precise, round and strong capsulorhexis
Better LRI (limbal relaxation incision) for astigmatism without perforation	Precise depth ,width and adjustable
Better IOL power prediction and centration with better vision outcome	Due to near perfect capsulorhexis
Better prevention of endophthalmitis	Due to better wound healing
No retina damage	Study by Palanker, et al

Discussion

Even though current studies support the safety and efficacy of FLACS,[8,10,21] the small patient population (between 40 to 60 eyes) and short-term follow-up (one hour to one year) of these studies limit the ability to adequately assess such safety factors. Even though the reoccurrence of cataract is not an issue, the posterior capsule haziness rates after surgery need to be compared between the laser group and the traditional group. Future studies will need to elucidate if there truly are superior visual outcomes in long-term follow-up of laser-assisted cataract surgery and if there is less endophthalmitis compare to conventional cataract surgery. A learning curve will be needed to master laser operation techniques to ensure the best outcomes. Complications may occur during the learning process such as rupture of the posterior capsule and dropped nucleus.[28]

FLACS may be difficult to apply to those patients who have deep set orbits or those with tremors or dementia or too deep sedation, since the initial docking of the lens requires patient cooperation. In addition, patients with posterior synechiae, intraoperative floppy iris syndrome or poor dilated pupil, small eye lid fissure and ocular motor paralysis may be poor candidates for FLACS.

The laser system is expensive to purchase (cost about three hundred thousand dollars) and to maintain (cost about forty thousand dollars a year) and the cost-benefit analysis has not yet been established. Surgical time usually is longer since it involves two surgeries. The cost of these laser machines plus the cost of PI (patient interface)(cost 325 dollars) will add considerable cost to the currently conventional procedure. The extra costs to the surgical center are incurred from a bigger space required to accommodate the laser and greater number of staff needed to assist in the procedure. This may be the main reason why the laser has had difficulty in achieving widespread utility and accessibility.

Conclusion

FLACS appears safe with many benefits (Table 1) in providing better outcomes for cataract surgery compared to conventional surgery. FLACS may be surgically indicated in some risky cataract cases such as hard nucleus and zonulopathy. However, continuous long term clinical studies of the outcomes of this laser surgery will provide data for cost-benefit analysis and the confirmation of its superiority over conventional surgery.

List of acronyms
FLACS: Femtosecond Laser Assisted Cataract Surgery
OCT: Optical Coherence Tomography
VM: Video Microscope
BCVA: Best Corrected Visual Acuity
FSL :Femtosecond Laser
IOP: Intra Ocular Pressure
CCI: Clear Corneal Incision
LRI: Limbal Relaxation Incision
IOL: Intra Ocular Lens

Disclosure and Conflict of Interest

The author reports no financial interest in any of the products in this article. The author reports no conflict of interest.

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References

1. Krasnov MM. Laser-phakopuncture in the treatment of soft cataracts, *Br J Ophthalmol.* 1975;59:96–8.
2. Peyman GA, Katoh N. Effects of an erbium: YAG laser on ocular structures. *Int Ophthalmol.* 1987;10:245–53.
3. Nagy, ZZ. 1-year clinical experience with a new femtosecond laser for refractive cataract surgery Paper presented at: Annual Meeting of the American Academy of Ophthalmology; October 24-27, 2009; San Francisco, CA.
4. Nagy, ZZ. Intraocular femtosecond laser applications in cataract surgery. *Cataract & Refractive Surgery Today.* September 2009:79-82.
5. Walkow T, Anders N, Pham DT, Wollensak J. Causes of severe decentration and subluxation of intraocular lenses. *Graefes Arch Clin Exp Ophthalmol.* 1998;236:9–12.[PubMed]
6. Cekic O, Batman C. The relationship between capsulorhexis size and anterior chamber depth relation. *Ophthalmic Surg Lasers.* 1999;30:185–90.[PubMed]
7. Wolffsohn JS, Buckhurst PJ. Objective analysis of toric intraocular lens rotation and centration. *J Cataract Refract Surg.* 2010;36:778–82.[PubMed]
8. Palanker DV, Blumenkranz MS, Andersen D, Wiltberger M, Marcellino G, Gooding P, et al. Femtosecond laser-assisted cataract surgery with integrated optical coherence tomography. *Sci Transl Med.* 2010;2:58ra85.
9. Slade SG. Illinois, USA: 2010. Oct 15-16, First 50 accommodating IOLs with an image-guided femtosecond laser in cataract surgery. In: Program and Abstracts of the Annual Meeting of ISRS.
10. Edwards KH, Frey RW, Naranjo-Tackman R, Villar Kuri J, Quezada N, Bunch T. Clinical outcomes following laser cataract surgery. *Invest Ophthalmol Vis Sci.* 2010;51E-Abstract 5394.
11. Taban M, Behrens A, Newcomb RL, and Nobe MY, Saedi G, Sweet PM, and et al. Acute endophthalmitis following cataract surgery: A systematic review of the literature. *Arch Ophthalmol.* 2005;123:613–20.

12. Xia Y, Liu X, Luo L, Zeng Y, Cai X, Zeng M, et al. Early changes in clear cornea incision after phacoemulsification: An anterior segment optical coherence tomography study. *Acta Ophthalmol.* 2009;87:764–8.
13. Ernest PH, Kiessling LA, Lavery KT. Relative strength of cataract incisions in cadaver eyes. *J Cataract Refract Surg.* 1991;17(Suppl):668–71.
14. Masket S, Sarayba M, Ignacio T, Fram N. Femtosecond laser-assisted cataract incisions: Architectural stability and reproducibility. *J Cataract Refract Surg.* 2010;36:1048–9.
15. Trivedi RH, Wilson ME, Jr, Bartholomew LR. Extensibility and scanning electron microscopy evaluation of 5 pediatric anterior capsulotomy techniques in a porcine model. *J Cataract Refract Surg.* 2006;32:1206–13.
16. Dick HB, Pena-Aceves A, Manns M, Krummenauer F. New technology for sizing the continuous curvilinear capsulorhexis: Prospective trial. *J Cataract Refract Surg.* 2008;34:1136–44.
17. Norrby S. Sources of error in intraocular lens power calculation. *J Cataract Refract Surg.* 2008;34:368–76.
18. Hollick EJ, Spalton DJ, Meacock WR. The effect of capsulorhexis size on posterior capsular opacification: One-year results of a randomized prospective trial. *Am J Ophthalmol.* 1999;128:271–9.
19. Friedman NJ, Palanker DV, Schuele G, Andersen D, Marcellino G, Seibel BS, et al. Femtosecond laser capsulotomy. *J Cataract Refract Surg.* 2011;37:1189–98.
20. Kránitz K, Takacs A, Mihaltz K, Kovacs I, Knorz MC, Nagy ZZ. Femtosecond laser capsulotomy and manual continuous curvilinear capsulorhexis parameters and their effects on intraocular lens centration. *J Refract Surg.* 2011:1–6.
21. Nagy Z, Takacs A, Filkorn T, Sarayba M. Initial clinical evaluation of an intraocular femtosecond laser in cataract surgery. *J Refract Surg.* 2009;25:1053–60.
22. Fishkind W, Uy H, Tackman R, Kuri J. Boston, Massachusetts: 2010. Apr 9-14, Alternative fragmentation patterns in femtosecond laser cataract surgery [abstract]. In: Program and Abstracts of American Society of Cataract and Refractive Surgeons Symposium on Cataract, IOL and Refractive Surgery.
23. Koch D, Batlle J, Feliz R, Friedman N, Seibel B. Paris, France: 2010. Sep 4-10, the use of OCT-guided femtosecond laser to facilitate cataract nuclear disassembly and aspiration [abstract]. In: Program and Abstracts of XXVIII Congress of the ESCRS.
24. Uy HS. Illinois, USA: 2010. Oct 15-16, Femtosecond laser lens fragmentation for higher grade cataracts. In: Program and Abstracts of the Annual meeting of ISRS.
25. Murano N, Ishizaki M, Sato S, Fukuda Y, Takahashi H. Corneal endothelial cell damage by free radicals associated with ultrasound oscillation. *Arch Ophthalmol.* 2008;126:816–21.
26. Shin YJ, Nishi Y, Engler C, Kang J, Hashmi S, Jun AS, et al. The effect of phacoemulsification energy on the redox state of cultured human corneal endothelial cells. *Arch Ophthalmol.* 2009;127:435–41.
27. Filkorn T, Kovacs I, Takacs A, et al. Comparison of IOL power calculation and refractive outcome after laser refractive cataract surgery with a femtosecond laser versus conventional phacoemulsification. *J Refract Surg.* 2012; 28(8):540-544.
28. Bali S J, Hodge C, Lawless M. Early experience with the femtosecond laser for cataract surgery. *Ophthalmology.* 2012;119(5):891-899.

Editor's Commentary

A main purpose of the *Hawai'i Journal of Medicine & Public Health* is education applicable to the medical and public health communities of Hawai'i and the Pacific Islands. Such education needs to be clearly separated from the "marketing" which often accompanies any new procedure, technique, or conclusion. Dr. Chen's even handed article has begun that task.

In a time of decreasing medical resources, there needs to be clear and unequivocal demonstration of net benefit to the patient and society rather than simple "non-inferiority." Multiple articles in the juried literature support this new laser technology yet some (*cf*. Femtosecond Laser for Cataract Surgery causes debate. *New Zealand Optics*, July 2012) raise issues of safety and cost.

We look forward to continued evaluation of the technique by the author with particular attention to statistically valid long term results.

Michael J. Meagher MD, Co-Editor
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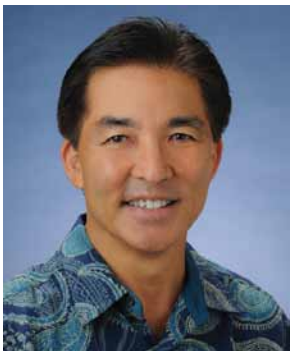

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Case of Levodopa Toxicity from Ingestion of *Mucuna gigantea*

Gary G. Tse MD; Brian B. Kim MD; Aaron M. McMurtray MD, PhD;
and Beau K. Nakamoto MD, PhD

Abstract

Hawai'i is home to 1000 native species of flowering plants. Mucuna gigantea *is one such Hawaiian species which has been studied as affordable sustenance and as a cover crop in developing countries.* Mucuna gigantea *and other* Mucuna *species (spp.) in general, are known to contain natural levodopa and its utility in the treatment of Parkinson's Disease has also been evaluated. Levodopa is converted in the periphery into dopamine which can then act on dopamine receptors to cause nausea, vomiting, arrhythmias, and hypotension. We describe a case in which a patient presents with abdominal pain, nausea, and vomiting after legume ingestion. The bean was ultimately identified as* Mucuna gigantea *and the patient was diagnosed with levodopa-induced gastrointestinal toxicity from consumption of the legume. A literature review was conducted using the database search engines, Biological Abstracts and PubMed, with a broad combination of keywords of which include "*mucuna*," "*gigantean*," "levodopa," "l-dopa," "toxicity," and the association between* Mucuna gigantea *ingestion and levodopa toxicity is discussed. These findings expand the differential diagnosis of abdominal pain associated with nausea and vomiting in the correct clinical context.*

Keywords

Mucuna gigantea*, Levodopa toxicity, l-dopa toxicity, legume*

Introduction

Hawai'i has approximately 1000 native species of flowering plants of which 90% are unique to the Hawaiian islands.[1] *Mucuna* genus is a legume in the family *Fabaceae* with around 100 different species found in tropical areas around the world, including Hawai'i.[1,2] Various *Mucuna* species have been studied in developing countries as cover crops for food self-sufficiency development and soil fertility improvement; furthermore, their bioactive substances have been thoroughly evaluated, particularly levodopa (L-DOPA).[3,4] *Mucuna* varieties grow natively in Hawai'i and inadvertent ingestion may produce signs and symptoms consistent with the pro-drug L-DOPA used in Parkinson's Disease (PD) treatment. The conversion of L-DOPA into Dopamine (DA) in the periphery and subsequent receptor binding lead to gastrointestinal (GI) symptoms of nausea, vomiting, cramping, as well as neurological side effects. Here we present a case of *Mucuna gigantea* ingestion, also known as Seabean, with subsequent L-DOPA toxicity and review the biochemical mechanisms of its side effects. A literature review was conducted using the database search engines, Biological Abstracts and PubMed, with a broad combination of keywords of which include "*mucuna*", "*gigantea*", "levodopa", "l-dopa", "toxicity", and the association between *Mucuna gigantea* ingestion and levodopa toxicity is discussed.

Case Report

A 27-year-old non-pregnant woman, with no significant past medical history, presented to the Emergency Department (ED) with acute onset abdominal pain, nausea, vomiting, and cramping. One hour prior to presentation, the patient was touring local farms and tried fruit from a tomato plant and beans from a green pod. Within 1 hour of consumption, patient became symptomatic with the aforementioned as well as dizziness and confusion. She denied any other symptoms. In the ED, patient's vital signs were stable and she appeared uncomfortable with active vomiting and a diffusely tender abdominal exam without peritoneal signs. The rest of the physical exam was unremarkable. Her laboratory analyses were all within normal limits and a urine drug screen was negative. While the patient could not tolerate oral contrast, a limited abdominal/pelvic CT with only IV contrast was unremarkable. After consultation with poison control, the patient was treated with anti-emetics, IV fluids and activated charcoal before admission to telemetry and monitoring with serial chemistry profiles and liver function tests. She progressively improved over 48 hours. Later, a botanist confirmed that the legume she had consumed was of the genus species *Mucuna gigantea*.

Discussion

Mucuna was first described in Ayurvedic texts as early as 1500 BC as a treatment for *Kampavata* (paralysis agitans), a neurologic disease with similar symptoms to PD.[5] Moreover, *Mucuna* extract is still used in modern India as a complementary treatment of PD. In contemporary medicine, *Mucuna* remains a plant of interest since its L-DOPA content and use in treatment of PD continues to be evaluated in biochemical research. One small randomized, controlled, double blind study of 8 PD patients comparing *Mucuna pruriens* seed extract versus synthetic L-DOPA/Carbidopa showed that natural L-DOPA had a more rapid onset of action and longer effect without increases in dyskinesias, when compared to synthetic L-DOPA formulations.[6] Although interesting, this study was limited by the small sample size and a heterogeneous treatment population since many of the patients were taking concomitant dopamine agonists and NMDA receptor antagonists. *Mucuna gigantea*, similar to other *Mucuna* spp., also contains L-DOPA and has been shown to induce mesenchymal stem cell expression of neural protein and genetic markers, similar to studies involving synthetic L-DOPA.[7,8]

Mucuna gigantea, also known commonly as Seabean, or in Hawaiian as *Kā'e'e*, is indigenous to the Hawaiian Islands. It is a vine plant that grows perennially and can extend up to 15 meters long, growing near the coast at lower elevations (Figures 1 through 3). The plant flowers range in color from green-yellow, and white-green; individual flowers are pendent,

Figure 1. Mucuna gigantea, flowers are pendent, round-topped, and umbel-like clusters.
(Plant images are reprinted with permission of wildlifeofhawaii.com)

Figure 2. Mucuna gigantea, leaves are trifoliolate, broadly elliptic in shape, mostly hairless.
(Plant images are reprinted with permission of wildlifeofhawaii.com)

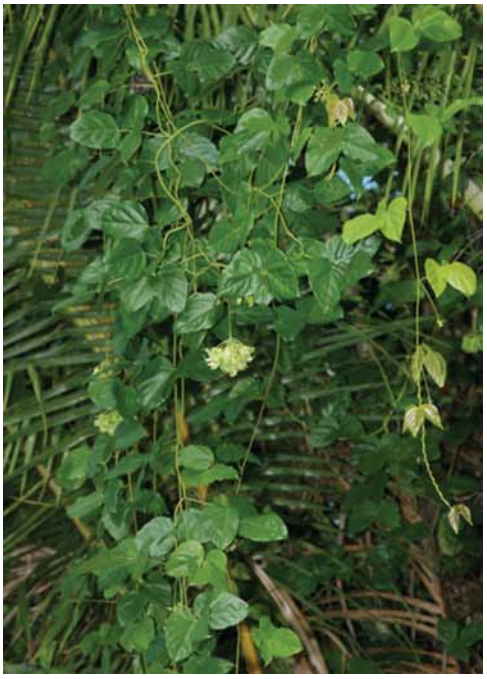

Figure 3. Mucuna gigantea, vines hang from trees and stems are slender and intertwine.
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Figure 4. Mucuna gigantea, drying green to brown legume pods with dark orange-brown.
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round-topped, and grow in clusters.[2] The plant also has bean pods that range in color from green to brown and are covered with brown hairs called trichomes (Figure 4). Leaflets are trifoliolate, hairless, and broadly elliptic in shape. The *Mucuna gigantea* seeds have a hamburger-like appearance and can be brown to black in color (Figure 5). These seeds have high amounts of crude protein, crude fat, total free phenols and tannins when compared to other legumes.[7] In one study, 1.5 grams of L-DOPA was isolated from 100 grams of seed flour, lower than values reported in other species of *Mucuna* described in the region.[7] From studies investigating *Mucuna gigantea* as a cover crop,

Figure 5. Mucuna gigantea, disk-like seeds with black hilum which are almost hamburger-like in appearance, are approximately 1 inch wide and can range from brown to black in color.
(Plant images are reprinted with permission of wildlifeofhawaii.com)

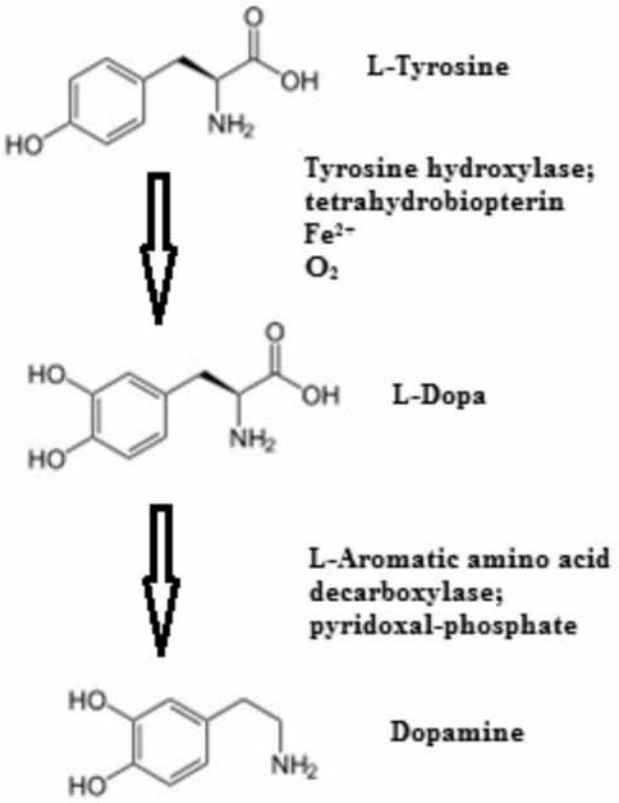

Figure 6. Schematic showing biosynthesis of dopamine from tyrosine with corresponding enzymes and co-factors.

researchers have showed that L-DOPA can be sufficiently reduced from being 4.93% of the content of unprocessed whole seeds to 0.04%, if seeds are cracked and rinsed under running water for 72 hours.[4] Although their conclusions are useful in the context of *Mucuna* as a cover crop, their findings could be criticized because they did not control for the shelf life of each batch of seeds prior to study analysis, did not discuss the natural half-life of L-DOPA within *Mucuna* beans, and did not correct for the risk of sampling error in the samples chosen for analysis.

Endogenous L-DOPA is formed from the amino acid tyrosine by the enzyme tyrosine hydroxylase (Figure 6). L-DOPA in the peripheral vascular system can be transported across the blood brain barrier (BBB) by a neutral amino acid transporter where it can then be decarboxylated by L-aromatic amino acid decarboxylase (AADC) into DA within the brain.[6] Since DA itself has a catechol moiety, it remains ionized at physiological pH which is the cause for its poor BBB permeability, and therefore the reason why PD cannot be treated directly with DA. This pharmacological and biochemical basis forms the rationale of the combination therapies available for PD. The oral bioavailability of synthetic L-DOPA is approximately 10% because of extensive first pass GI metabolism; only 1%-3% of the original dose is transported across the BBB unchanged.[10]

L-DOPA, whether synthetic or natural from a *Mucuna* bean, is readily converted by AADC into DA in the GI tract (Figure 6). In fact, dopamine is found to be significantly abundant in the intestinal mucosal cell layer and these same epithelial cells, particularly those localized to the jejunum, are rich in AADC.[11-13] Using brain tissue for controls, Eaker, et al, showed that dopamine is indeed abundant and localized in the intestinal mucosal layer by treating gut tissue with neurotoxin 6-OHDA to decrease dopamine extraction and elution versus controls, and that DOPAC (a DA metabolite) could be directly extracted from gut tissue, suggesting that gut DA acts independently as a neurotransmitter rather than as a norepinephrine precursor. It is well known that endogenously catecholamines play an important role in the regulation of body fluid and electrolyte homeostasis in the intestinal tract. Therefore, conversion of exogenous L-DOPA to DA by mucosal epithelial cell AADC, such as in our patient with ingestion of *Mucuna gigantea* seeds, leads to aberrantly elevated DA levels and subsequent manifestation of GI and cardiovascular symptoms due to concomitant fluid and electrolyte dysregulation.

All five classes of DA receptors (D1-D5) are expressed in the proximodistal axis of the bowel.[14] Moreover, Li, et al, showed, using both RT-PCR and in situ hybridization, that DA receptors are present in the gut smooth muscle, myenteric plexus, and mucosa as early as embryonic day 10, even before the appearance of neurons. Exogenously converted DA will then act predominately on D1 dopaminergic receptors, activating adenylyl cyclase in smooth muscle cells, increasing cAMP and creating vasodilatation in coronary, mesenteric, and renal vascular beds.[15] Vasodilatation in the mesenteric vasculature can lead to the abdominal pain and cramping as the mucosal wall can become edematous. Dopamine also acts as an indi-

rect anti-cholinergic in the GI tract through D2 receptors that are prominent on the processes of myenteric and submucosal neurons. DA binds to axonal D2 receptors within the ganglia, decreasing acetylcholine release from post-ganglionic nerve terminals as well as de-sensitizing muscarinic receptors of GI smooth muscles, which effectively decreases prokinetic signals.[11,12,14] This leads to loss of peristalsis, decreased gastric motility, and dysregulation of prokinetic GI secretions which contributes to abdominal pain, nausea, and vomiting associated with an ileus. Decreasing cholinergic tone in the GI tract also leads to decreased esophageal sphincter tone, further mediating emesis. Dopamine also stimulates D2 receptors in the area postrema which directly induces nausea and vomiting.[9] This is actually the basis for some drugs that treat nausea and vomiting such as the D2 antagonist, Metoclopramide.[16] These same mechanisms that lead to change in intra and extracellular signaling can cause cardiovascular side effects such as arrhythmias and hypotension. Excess DA from L-DOPA in *Mucuna gigantea* seeds that do reach the CNS may mediate neurologic side effects; DA involvement in the nigrostriatal and tubero-infundibular pathway may lead to altered mental status, confusion, and even hallucinations if ingested in high concentrations.

This case adds to the differential for patients presenting with abdominal pain, nausea, and vomiting with unremarkable labs and imaging, as well as reviews the biochemical mechanisms behind L-DOPA toxicity. The differential remains broad for such nonspecific GI complaints and may include GI ova and parasites, bacterial or viral gastroenteritis, bacterial toxin (food) poisoning, mesenteric ischemia, trauma, anatomical or pathological obstruction, among others. Yet in the appropriate clinical scenario legume ingestion with or without neurologic symptoms in the context of normal stool studies and unremarkable imaging, L-DOPA toxicity should be considered.

Disclosure Statement/Conflict of Interest

This study used resources provide by NIH (U54MD007584). The authors report no conflict of interest.

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References

1. Native Plants of Hawaii. Mucuna gigantea. http://www.nativeplants.hawaii.edu/. University of Hawaii. Accessed October, 2012.
2. Wildlife of Hawaii. Mucuna gigantea seabean. http://wildlifeofhawaii.com/flowers/1132/mucuna-gigantea-seabean/. Accessed October 2012.
3. Adebowale YA, Adeyemi IA, Oshodi AA. Functional and physicochemical properties of flours of six Mucuna Species. *Afr. J. Biotechnol.* 2005;4(12):1461-1468.
4. Diallo OK, Berhe T. Processing of Mucuna for Human Food in the Republic of Guinea. *Trop. Subtrop. Agroecosyst.* 2003;1:193-196.
5. Manyam BV. Paralysis agitans and levodopa in "Ayurveda": ancient Indian medical treatise. *Mov Disord.* 1990;5(1):47-8.
6. Katzenschlager R, Evans A, Manson A, Patsalos PN, Ratnaraj N , Watt H, Timmerman L, Van der Giessen R, Lees AJ. Mucuna pruriens in Parkinson's disease: a double blind clinical and pharmacological study. *J Neurol Neurosurg Psychiatry.* 2004;75(12):1672-7.
7. Rajaram N, Janardhanan K. The biochemical composition and nutritional potential of the tribal pulse, Mucuna gigantea (Willd) DC. *Plant Foods Hum Nutr.* 1991; 41(1):45-51.
8. Kongros K, Bunyaratvej A, Viyoch J, Sila-asna M. The effects of seed extract of Mucuna gigantea on the expression of neural markers of mesenchymal stem cells. *J Med Plants Res.* 2012; 6(7):1297-1303
9. Golan D, Tashjian A, Armstrong E, Amstrong A. *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy.* Philadelphia, PA: Lippincott Williams & Wilkins; 2011.
10. Standaert D, Young A. *Treatment of Central Nervous System Degenerative Disorders. The Phamacological Basis of Therapeutics.* New York, NY: McGraw Hill; 1996.
11. Vieira-Coelho MA, Gomes P, Serrao MP, and Soares-da- Silva P. Renal and intestinal autocrine monoaminergic systems: dopamine versus 5-hydroxytryptamine. *Clin. Exp. Hypertens.* 1997;19:43–58.
12. Eaker EY, Bixler GB, Dunn AJ, Moreshead WV, and Mathias JR. Dopamine and norepinephrine in the gastrointestinal tract of mice and the effects of neurotoxins. *J. Pharmacol. Exp. Ther.* 1998;244:438–442.
13. Vieira-Coelho MA, and Soares-da-Silva P. Dopamine formation, from its immediate precursor 3,4-dihydroxyphenylalanine, along the rat digestive tract. *Fundam. Clin. Pharmacol.* 1993;7:235–243.
14. Li ZS, Schmauss C, Cuenca A, Ratcliffe E, Gershon MD. Physiological modulation of intestinal motility by enteric dopaminergic neurons and the D2 receptor: analysis of dopamine receptor expression, location, development, and function in wild-type and knock-out mice. *J Neurosci.* 2006 ;26(10):2798-807.
15. Di Stefano A, Sozio P, Cerasa LS. Antiparkinson prodrugs. *Molecules.* 2008;13(1):46-68.
16. Riyad A and McCallum MW. Metoclopramide: Pharmacology and Clinical Application. *Ann Intern Med.* 1983;98(1):86-95.

Utilization of Children with Special Health Care Needs (CSHCN) Screener© by O'ahu's Pediatricians

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Abstract

O'ahu's primary care physicians are in the process of implementing the Patient-Centered Medical Home (PCMH) model. The Medical Home Task Force recommends the implementation of the Children with Special Health Care Needs (CSHCN) Screener© as one of the two quality improvement programs that must be completed by each participating physician. This study sought to find how many pediatricians practice population health management and to determine barriers for incorporating population health management and care registries into practices.

An online survey of 55 pediatricians in Hawai'i was conducted between January 10, 2012 and March 10, 2012. The survey contained questions regarding knowledge and use of population health management and investigated the utilization rate of the Screener©. This survey provides baseline data on the implementation of this recommended screener, and informs the process that will be necessary to ensure maximal adoption of recommendations.

Sixty percent of the survey participants have not incorporated population health management into their routine practice. Twenty three percent did not have knowledge of population health management and 85% did not use a chronic disease registry. As of August 2011, 95% had not screened their patients with the Screener©. Reasons included not having heard of the Screener© and never having considered using a systematic process to ask patients to assess their health.

Based on results, there are important educational goals that need to be accomplished in order for Hawai'i's physicians to transform their practices into effective PCMHs. Physicians will likely need instructional and monetary support to effectively change their practices into PCMHs.

Keywords

population health management, children with special health care needs, patient-centered medical home, pediatric practice, CSHCN, PCMH

Background

Population health is a conceptual approach to identifying the determinants of health status affecting a particular group.[1,2] To utilize population health concepts is to take a step beyond the individual-level focus of mainstream medicine by addressing a broad range of factors that impact the health of an entire population group.[3] A good population health management program is cognizant of the many elements which affect the wellbeing of a particular population and has access to programs that target health needs of that population.

According to the American Academy of Pediatrics,[4] the medical home is "a partnership approach with families to provide primary health care that is accessible, family centered, coordinated, comprehensive, continuous, compassionate, and culturally effective." In order to perform the functions of a medical home, physicians would do well to understand and use population health management concepts. With use of these concepts, for example through disease management, individuals with complex medical needs would have better access to health care, increased satisfaction with care, and ultimately improved health of a specific population.[5,6]

Children with Special Health Care Needs (CSHCN) are one particularly important pediatric population that can benefit from application of population health management concepts. The Health Resources and Services Administration, Maternal and Child Health Bureau defines children with special health care needs as "those who have a chronic physical, development, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally."[7] The 2009/10 National Survey of Children with Special Health Care Needs (NS-CSHCN) conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics showed that Hawai'i's prevalence of CSHCN is 45,700 (12.3%), while the national prevalence is 11.2 million (15.1%).[8] Additionally, nationwide over 1 in 5 households with children have at least one child with a special health care need.[8] This statistic translates into almost 9 million households. The 2009/10 survey also showed that in Hawai'i, 29.0% of CSHCN did not receive care coordination within a medical home, 33.2% did not receive family-centered care, and 22.4% of CSHCN families were not partners in care decision making at all levels.[8]

The Child and Adolescent Health Measurement Initiative, in collaboration with the National Committee for Quality Assurance, has developed a questionnaire called the Children with Special Health Care Needs (CSHCN) Screener©, hence forth referred to as "screener." The screener helps a family identify their child's need for extra services due to existing chronic conditions.[9] Children's health care needs status is assessed by asking questions about prescription medications, need or use of services, functional limitations, specialized therapies, and counseling. (A copy of the screening instrument is provided in Appendix A.) The screener is used in several surveys, including the Medical Expenditure Panel Survey, the National Survey of Children's Health, and the National Survey of Children with Special Health Care Needs (NS-CSHCN).[8,10] This tool gives physicians the opportunity to engage in a more comprehensive needs assessment based on a family's perception. The screener enables physicians to identify CSHCN in their practice as a population and to examine whether comprehensive care is provided for the CSHCN population.

The screener is important because the overall health of a child is influenced by multiple factors and it may be difficult to identify all of these factors during a single office visit with their health care provider. The CSHCN population shares many common health-related needs and issues. In addition, they often experience more than one condition at a time. Focusing on single conditions is both limiting and often impractical due to the large number of relatively low prevalence childhood chronic

conditions.[10] Population health management programs begin with the identification of the population at risk. The screener is recommended by the American Academy of Pediatrics as one of three screening tools that can be used to identify CSHCN.[11] The screener was selected as the screening tool in this study because the screener is the only nationwide tool that allows comparison of Hawai'i's profile with NS-CSHCN's data. Results from a study in 2002 indicate that the screener requires minimal time to administer, is acceptable for use as both an interview-based and self-administered survey, and provides a comprehensive yet simple method for identifying CSHCN.[12] Thus, it would appear that the screener would be an ideal tool for pediatricians to begin that identification process which could then lead them to improve population health management skills.

The 2009/10 NS-CSHCN[8] showing that 29% of Hawai'i's CSHCN do not receive comprehensive, coordinated care in a medical home setting has room for improvement. Possible reasons for this issue include: physicians lacking an understanding of population health management, and/or physicians not having a mechanism to identify their children with special health care needs. To elucidate these questions, a survey was administered to a select group of pediatricians in Hawai'i to find out how many of them had knowledge of population health management, how many practiced population health management, and how many utilized the screener in their office.

Methods

A baseline survey with twelve questions (Appendix B) was designed and created in Survey Monkey© and then emailed on January 10, 2012 to 55 O'ahu physicians participating in the Patient-Centered Medical Home (PCMH) project. To participate in the PCMH project, physicians had to be primary care, general pediatricians practicing in Hawai'i, with email access and have a minimum patient panel size of 150 members covered under one of the Hawai'i Medical Service Association (HMSA)'s commercial plans, ie, the Preferred Provider Plan (PPP) and the Health Plan Hawai'i, a health maintenance organization (HMO). In addition, participating pediatricians have opted to work with the Hawai'i Chapter of the American Academy of Pediatrics (HAAP) to facilitate transformation through HMSA's PCMH project. Participants did not receive any monetary incentives. All participating physicians had a signed agreement with an Independent Practice Association to participate in the PCMH project. (For a more detailed explanation of the selected group size, refer to Appendix C.) Participants' age, gender, race, and practice location varied.

The survey, conducted between January 10, 2012 and March 10, 2012, consisted of 12 multiple-choice questions in total, 8 of which had comment boxes. The questions had a "skip logic" sequence and the questions presented to each respondent depended on the respondents' preceding answers. Thus, respondents were not presented with all 12 questions, but were required to answer all presented questions. The survey questions were grouped by categories which asked general questions about population health, the use of population health in the physician's practice, and the use of the screener for detection of children with special health care needs. Expected completion time was 5 to10 minutes. On January 23, 2012, there were 26 non-respondents and all were sent a reminder email.

Results

Forty out of the fifty-five (73 %) PCMH physicians completed the survey. Survey responses are highlighted in Table 1.

Table 1. Physician Responses to Survey, N= 40

Physician Agreement by Item	Percentage (%)
I do not use the screener for CSHCN.	95
I do not use a chronic disease registry.	85
Population health management is not part of my practice.	60
I don't know what population health management is.	23

Sixteen participants said they incorporated population health management in their practice. Descriptions of their methods vary and include a pilot of the CSHCN Screener©, Electronic Medical Record data tracking and warnings, Body Mass Index (BMI) lists, advising patients on better eating habits and exercising more, and assessing patient wellness, prevention, and needs. Six participants said they used a chronic disease management system in their office. Descriptions of their methods also varied and included the use of a BMI registry, a problem list attached to the front of the patients' charts, and the CSHCH Screener©. The top five reasons why physicians did not use the screener are included Table 2.

Table 2. Reasons for not using the screener (multiple answers were allowed), N= 38

Physician reasons for not using the screener	Percentage (%)
I have never heard of the CSHCN Screener©.	42
I have not considered incorporating a systematic process to ask my patients to assess their own health.	24
The Screener© is work that I do not get paid for.	8
I am using another tool.	8
I cannot incorporate the Screener© into my EMR.	5
Patients do not understand the Screener©.	5

Discussion

Effective medical homes are accessible, family-centered, comprehensive, coordinated, and culturally competent.[4,6] Hawai'i performs above the national average in health measures such as preventive health care, health care service needs and access, and the minimal quality of care index.[8] However, CSHCNs have a lower average in health care measures than non-CSHCN.[7,8,10] If CSHCNs are less likely to receive services consistent with medical home criteria than the general pediatric population, this could be partly explained by pediatricians not using a standard method of identification of the CSHCN population.

Data from our baseline survey show that 95% of surveyed pediatricians did not screen patients with the screener and 85% of physicians did not use a chronic disease registry to identify specific populations in their practice. When given a list of characteristics of population health management, 23% of physicians said they did not know what population health management is. The survey indicates that the top reasons why physicians do not implement the screener may be that physicians lack knowledge about the screener, have not considered incorporating a systematic process to ask patients to assess their own health, and do not get paid for using the screener.

Based on reports from parents in the 2007 National Survey of Children's Health (NSCH),[13] collected by the CDC, 60.2% of all children in Hawai'i below the age of 18 have a medical home that meets all medical home criteria. The 2007 NSCH indicates that families receive comprehensive, ongoing, and coordinated care only 47.6% of the time.[13] In this study, 60% of physicians indicated that they do not incorporate population health management in their practice. Population health management is a crucial component of ability to deliver comprehensive, coordinated care for an entire practice. To improve the care of our children with special health care needs, physicians need to understand population health management and have a process to identify their children with chronic conditions that require special health care.

There are limitations to this study that need to be considered. A primary limitation is the lack of survey validation because the survey was created for this project. The survey was designed to support a quality improvement effort by providing baseline data on the implementation of this recommended screener. Also, the number of participants was limited to 55 physicians on O'ahu. Pediatricians from Kaua'i, Maui, Moloka'i, and the Big Island were not represented in the survey. The size of the patient panel varied and the extent of the physicians' training on PCMH was not queried. Family practitioners did not participate in the survey. Potential biases of the baseline survey include selection bias and response bias. The group of physicians who received the survey was not selected at random and had to have chosen to participate in this PCMH project. Therefore, one would expect them to be more likely to use a screener. In addition, each physician had to have a minimum of 150 patients covered under the HMSA PPP/HMO health plan in order to qualify for this program. That requirement may have excluded recent graduates and younger physicians who might have received training and education on population health management. Although the response rate was satisfactory at 73%, the survey was not anonymous so there also could have been some response bias. Demographic comparison between respondents and non-respondents from collected data was not possible so generalizability of the data was not determined.

Nevertheless, the results from the survey are valuable because they clearly illustrate that pediatricians are not using chronic disease registries and do not have a standardized approach to identify CSHCN. The survey responses showed a lack of knowledge and utilization of population health management concepts. This lack of knowledge and utilization should be addressed because of the potential social and economic savings that could arise if population health management, use of chronic disease registries, and screening for children with special health care needs were routinely employed by physicians.[7]

Based on the survey responses, the two major reasons physicians cite for not using the screener are not considering to routinely query families about their perceptions of their child's health and not being familiar with the screener. Increasing awareness about the concepts of population health management and means to identify children with special care needs will benefit our community. With support from the health care system, physicians can become fully engaged in the medical home concept and PCMH techniques. If all providers who care for children in Hawai'i uniformly screened their patients for special health care needs and had a process in conjunction with a health plan to aggregate and examine their population data, the quality of patient care would improve and would likely lead to an overall reduction in the cost of medical care.

Conclusion

The future of primary care relies on transforming physician practices into patient-family centered medical homes where patient health is seen holistically and in the context of the larger population. To accomplish this transformation, primary care physicians need to incorporate population health management into their practices.

Barriers towards implementation of routine screening of all children with the screener include:

1. Pediatricians must understand the value of proactively identifying CSHCN.
2. Pediatricians must find a way to routinely incorporate the screener into their daily workflow.
3. Offices must find the time and be able to evaluate the family responses on the screener.
4. Offices must be able to "flag" a patient's chart as CSCHN so their office will continue to identify that child during every encounter and consider what extra care should be provided, given the child's identified needs.
5. Practices need to have an ongoing process to re-assess the status of each child.
6. Physicians must be able to track their CSHCN and have the time and resources to analyze their practice in terms of how many patients are CSCHN and what kind of disease processes and/or health needs their patients have.

These barriers can be overcome if the physician can gain an understanding and commit to transforming their practice into PCMHs, incorporate population health management concepts into their practice, and receive support from the health plan. The health plan can use this data generated from wide spread use of the screener to allocate appropriate resources to CSCHN and the practices that serve them.

For providers who care for children, using the screener appears to be a simple patient-centered tool that can help primary care pediatricians identify their patients with chronic health conditions and needs as identified by their families. This survey reveals there are many work, education, and system changes that are needed in Hawai'i in order for pediatricians to transform their practices. To effectively manage population health, practices will need to restructure their workflow and adopt health tools such as the screener, which will enable them to reach out to patients who need services and track their population. Use of the screener in conjunction with PCMH transformation may lead physicians and the health system toward identifying patient population characteristics and building a more sustainable health care system that provides quality care at an affordable cost.

Conflict of Interest

None of the authors identity any conflict of interest.

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References

1. McDowell I, Spasoff RA, Kristjansson B. On the Classification of Population Health Management Measures. *American Journal of Public Health*. (March 2004) *94*(3),388-93.
2. Skoch EM, McMillen M. (2008). *Improving the Patient's Experience*. [Fact Sheet]. TransforMed. Retrieved on March 29, 2012 from www.transformed.com/workingPapers/ImprovingPatientExperience.pdf.
3. Shi L, Singh D. (2011). *Delivering Health Care in America: A Systems Approach* (5th Ed.). Burlington, MA: Jones & Bartlett Learning.
4. American Academy of Pediatrics. (2002). Medical Home Initiatives for Children with Special Needs Project Advisory Committee. The medical home. *Pediatrics*. (March 2004) 110 :184– 186.
5. Kindig D, Stoddart G. What Is Population Health? *American Journal of Public Health*. (March 2003). 93(3),380-3.
6. Sia C, Tonniges TF, Osterhus E, Taba S. History of the medical home concept. *Pediatrics*. (May 2004). 113(5 Suppl):1473–8.
7. U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. *The National Survey of Children with Special Health Care Needs Chartbook 2005–2006*. Rockville, Maryland: U.S. Department of Health and Human Services, 2007.
8. National Survey of Children with Special Health Care Needs. (2009/10). Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved on September 29, 2012 from http://www.childhealthdata.org/browse/survey.
9. "Who are Children with Special Health Care Needs?" Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved on March 29, 2012 from http://childhealthdata.org/docs/nsch-docs/whoarecshcn_revised_07b-pdf.pdf.
10. Child and Adolescent Health Measurement Initiative. *2009/10 National Survey of Children with Special Health Care Needs*, Data Resource Center for Child and Adolescent Health website. Retrieved on June 4, 2012 from www.childhealthdata.org.
11. CYSHCN Screener. American Academy of Pediatrics. Retrieved on September 29, 2012 from http://www.pediatricmedhome.org/progress_summary/tools_index.aspx.
12. Bethell CD, Read D, Stein REK, Blumberg SJ, Wells N, Newacheck PW. Identifying Children with Special Health Care Needs: Development and Evaluation of a Short Screening Instrument. *Ambulatory Pediatrics*. (2002). 2:38-48.
13. 2007 Hawaii Report from the National Survey of Children's Health. (2009). Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved on May 19, 2012 from www.childhealthdata.org.

Appendix A. Children with Special Health Care Needs Screener©

Children with Special Health Care Needs (CSHCN) Screener©
(mail or telephone)

1. Does your child currently need or use **medicine prescribed by a doctor** (other than vitamins)?
☐ Yes → Go to Question 1a
☐ No → Go to Question 2

1a. Is this because of ANY medical, behavioral or other health condition?
☐ Yes → Go to Question 1b
☐ No → Go to Question 2

1b. Is this a condition that has lasted or is expected to last for *at least* 12 months?
☐ Yes
☐ No

2. Does your child need or use more **medical care, mental health or educational services** than is usual for most children of the same age?
☐ Yes → Go to Question 2a
☐ No → Go to Question 3

2a. Is this because of ANY medical, behavioral or other health condition?
☐ Yes → Go to Question 2b
☐ No → Go to Question 3

2b. Is this a condition that has lasted or is expected to last for *at least* 12 months?
☐ Yes
☐ No

3. Is your child **limited or prevented** in any way in his or her ability to do the things most children of the same age can do?
☐ Yes → Go to Question 3a
☐ No → Go to Question 4

3a. Is this because of ANY medical, behavioral or other health condition?
☐ Yes → Go to Question 3b
☐ No → Go to Question 4

3b. Is this a condition that has lasted or is expected to last for *at least* 12 months?
☐ Yes
☐ No

4. Does your child need or get **special therapy**, such as physical, occupational or speech therapy?
☐ Yes → Go to Question 4a
☐ No → Go to Question 5

4a. Is this because of ANY medical, behavioral or other health condition?
☐ Yes → Go to Question 4b
☐ No → Go to Question 5

4b. Is this a condition that has lasted or is expected to last for *at least* 12 months?
☐ Yes
☐ No

5. Does your child have any kind of emotional, developmental or behavioral problem for which he or she needs or gets **treatment or counseling**?
☐ Yes → Go to Question 5a
☐ No

5a. Has this problem lasted or is it expected to last for *at least* 12 months?
☐ Yes
☐ No

Appendix B. Baseline Survey to Physicians

Baseline Survey

The HMSA Patient Centered Medical Home Initiative requires that each practitioner complete two quality improvement programs by the end of 2012. We recommend that you focus your first quality improvement program on implementing the CSHCN Screener©. To establish your baseline data, please fill out the following survey. There are eleven questions that should take you no more than 5-10 minutes to complete. If you have questions, please email either gchock@aap.net or Leolinda@resqconsultants.com.

1. What are the components of population health management? Please check all that apply.
__ Assessing patients' wellness, prevention, acute, chronic and end-of-life needs across time.
__ Identification of populations of patients with common health issues within your practice.
__ Comprehensive needs assessment of the identified patient population.
__ Proactive health promotion to facilitate patients' understanding of health risks. associated with personal lifestyles and behaviors.
__ Targeted interventions aimed at reducing health care risks and modifying patient behavior.
__ Routine data measurement and feedback to evaluate the outcome of interventions.
__ Routine assessment of the overall health of the identified population.
__ Routine use of economic and health care utilization indicators.
__ I don't know what population health management is.
__ I don't care what population health management is.

2. Have you incorporated population health management in your practice?
__ Yes
__ No
If yes, please describe how you use population health management.
_____

3. Do you use a chronic disease management system (registry) in your office?
__ Yes
__ No
If yes, please describe your registry.
_____

4. Is your office participating in a continuous quality improvement program?
__ Yes
__ No
If yes, please share with us what program you are using.
_____

5. Have you ever completed a PlanDoStudyAct (PDSA) cycle?
__ Yes
__ No
If yes, please briefly describe your PDSA.
_____

6. Have you used HBI Online?
__ Yes
__ No

7. Does HBI Online help you proactively manage your patients?
__ Yes
__ No
Please share with us your thoughts about HBI Online:
_____

8. Do you use HMSA Online Care?
__ Yes
__ No
Please share with us your thoughts about HMSA Online Care:
_____

9. Why do you not use HMSA Online Care?
_____

10. Prior to August 2011, did your office screen patients with the Children with Special Health Care Needs Screener©?
__ Yes
__ No

11. What percent of your patients have been screened?
__ 1-25%
__ 26-50%
__ 51-75%
__ 76-100%

12. Please tell us why you have not used the CSHCN Screener©. (Check all that apply.)
__ Never heard of it.
__ I have not considered incorporating a systematic process to ask my patients to assess their own health.
__ I don't need or want a systematic process to ask my patients to assess their own health.
__ The Screener© is too complicated for our office to use.
__ Patients do not understand the Screener©.
__ The Screener© is only available in English; my patients cannot read English.
__ My staff does not want to use the Screener©.
__ We do not have time to use the Screener©.
__ I cannot incorporate the Screener© into my EMR.
__ The Screener© is work that I do not get paid for.
__ I am using another tool. (Please describe your tool in the comment box below.)
__ Other. (Please explain/ describe in the comment box below.)
_____

If you have questions, please email Dr. Galen Chock at gchock@aap.net, or Leolinda Parlin at leolinda@resqconsultants.com. Please click the "DONE" button to submit your survey. Thank you.

Appendix C. Reason for Selected Group Size

Hawai'i Medical Service Association (HMSA), an independent licensee of the Blue Cross and Blue Shield Association, set a minimum panel size of 150 Preferred Provider Plan (PPP)/Health Management Organization (HMO) patients in order for the primary care pediatrician to participate. The Hawai'i Chapter of the American Academy of Pediatrics has an agreement with HMSA to partner with other Independent Physician Associations (IPAs) to facilitate the transformation of primary care pediatric offices into Patient-Centered Medical Homes. HMSA set the group size to 55 pediatricians.

Liver Disease Among Children in Hawai'i Diagnosed with Metabolic Syndrome

David E. St-Jules RD; Corilee A. Watters PhD, RD; James Davis PhD; and Sorrell H. Waxman MD

Abstract

The purpose of this study was to evaluate the prevalence of and factors related to liver disease among children in Hawai'i with metabolic syndrome. The medical charts of children diagnosed with metabolic syndrome by an outpatient endocrinologist between January 2000 and December 2010 were reviewed. Liver disease prevalence was estimated based on serum alanine aminotransferase (ALT) levels, which were then assessed for associations with demographic (age, gender, ethnicity), anthropometric (body mass index), biochemical (fasting blood glucose, hemoglobin A1c, triglycerides, and total, LDL- and HDL-cholesterol), and clinical (blood pressure) characteristics of subjects. Serum ALT was available for 167 of the 195 subjects. The proportion of subjects with liver disease (105/167 [63%]) was greater than many traditional features of metabolic syndrome including hypertriglyceridemia (73/177 [41%]), hypertension (37/194 [19%]) and hyperglycemia (37/170 [22%]). Serum ALT values were positively associated with age (P = .030), and liver disease was more common among boys than girls (62/91 [68%] vs 43/76 [57%]), although this difference was not statistically significant (P = .123). There was a significant difference in liver disease across ethnicities (P = .029), and appeared to be more common in children with Pacific Islander surnames (14/16 [88%]), and less common in children with Hispanic surnames (7/20 [35%]). Diastolic blood pressure was the only obesity-related disease parameter associated with serum ALT after adjusting for age and gender (P = .018). In conclusion, liver disease was common among children diagnosed with metabolic syndrome in Hawai'i. Age, gender, and ethnicity may be important determinants of liver disease risk, and should be investigated further.

Introduction

Childhood obesity is a major health concern in Hawai'i. According to the Hawai'i Youth Risk Behavior Survey, over one-quarter of adolescents are overweight or obese.[1] The term metabolic syndrome has been adopted to describe the clinical and biochemical derangements related to excess body fat. The definition of metabolic syndrome in children has yet to be clearly determined, but usually includes measures of central adiposity, insulin resistance, dyslipidemia, and hypertension.[2] Nonalcoholic fatty liver disease (NAFLD) is another consequence of obesity that is closely linked to metabolic syndrome, and has been proposed as a defining feature of the condition.[3-5]

Most children with NAFLD suffer from non-specific symptoms such as fatigue, which contribute to lower physical and psychosocial health, and reduced quality of life.[6] The prevalence and clinical spectrum of pediatric NAFLD varies considerably between populations, but affects roughly 40% of obese adolescents in the United States, and presents with hepatic inflammation and/or fibrosis in the majority cases.[7-10] Despite rapidly becoming the leading cause of liver disease in adolescents, screening for elevated hepatic transaminases in serum (transaminasemia) indicative of NAFLD, namely alanine aminotransferase (ALT), is still rarely carried out during general pediatric visits of at-risk subjects.[11]

Presently, no studies have been published looking at the epidemiology of NAFLD among children in Hawai'i. In view of the varied risk of pediatric NAFLD and the unique ethnic makeup of Hawai'i, it is important to evaluate its present burden.[12-14] The purpose of this study is to evaluate the prevalence of and factors related to elevated serum ALT values indicative of liver disease in children diagnosed with metabolic syndrome in Hawai'i.

Methods

Subjects

The study sample included consecutive patients referred to the outpatient pediatric endocrinologist at Kapi'olani Medical Center for Women and Children (KMCWC) between January 2000 and December 2010 who were described as having "metabolic syndrome" during the initial consultation at age 1-19 years old. Demographic, anthropometric, biochemical, and clinical data were collected from the patient's medical charts. The University of Hawai'i and Hawai'i Pacific Health Institution Review Boards approved this study.

Height and weight were converted into body mass index (BMI) standard deviation score (SDS) for age and gender according to the 2000 CDC growth charts using the lambda, mu, and sigma (LMS) technique.[15] Systolic and diastolic blood pressures were converted into SDSs for age, gender and height as described previously.[16] The prevalence of metabolic syndrome features was evaluated based on the criteria from Graham, et al (2009), except for central obesity, which was approximated using the body mass index (BMI), a measure of excess body weight, because waist circumference was not available (Table 3).[12] Subject ethnicity was determined using the surname list method developed for the Multiethnic Cohort Study (MEC), and grouped according to the National Institutes of Health (NIH) standards for race and ethnicity as Asian (Chinese, Filipino, Japanese), Hispanic, Pacific Islander (Hawaiian, Samoan), or White (surname not found).[17-18] Although both White and African American ethnicities were not available in the MEC surname list, it is expected that the majority of these subjects would have been White based on the ethnic makeup of Hawai'i.[19] Surnames that corresponded to more than one ethnicity were assigned to the dominant ethnicity in Hawai'i.[19]

The Upper Limit of Normal (ULN) for serum alanine aminotransferase (ALT) varies considerably between facilities, largely due to differences in reference populations used.[20] As per a telephone communication with the laboratory manager Teresa Walsh (December 18, 2012), Clinical Laboratories of Hawai'i, which provides laboratory services to KMCWC, use

Table 1. Characteristics of Subjects by Serum Alanine Aminotransferase Status						
	Normal ALT		Elevated ALT		Normal vs Elevated ALT (P-value)	
Characteristic	**n**	**Values**	**n**	**Values**	**Univariate Analysis**	**Logistic Regression**
Age (years)	62	12.1 (9.3-14.2)	105	12.2 (9.9-15.2)	0.369	0.362
Gender (n Male)	62	29 (47%)	105	62 (59%)	0.123	0.129
Ethnicity (n)	62		105		0.012	0.029
Asian		28 (45%)		51 (49%)	0.898	0.800
Hispanic		13 (21%)		7 (7%)	0.029	0.049
Pacific Islander		2 (3%)		14 (13%)	0.069	0.093
White (reference)		19 (31%)		33 (31%)		
Body Mass Index (SDS)	62	2.35 (2.13-2.61)	104	2.54 (2.27-2.75)	0.036	0.048
Fasting Blood Glucose (mg/dL)	54	89 (83-97)	94	96 (87-111)	0.007	0.216
Hemoglobin A1c (%)	48	5.7 (5.5-6.0)	92	5.8 (5.6-6.3)	0.119	0.882
Total Cholesterol (mg/dL)	56	164 (142-188)	100	165 (146-193)	0.519	0.483
LDL-Cholesterol (mg/dL)	52	94 (81-117)	97	97 (81-125)	0.663	0.592
HDL-Cholesterol (mg/dL)	53	41 (35-46)	99	38 (32-44)	0.114	0.117
Triglycerides (mg/dL)	53	118 (73-172)	99	145 (81-206)	0.144	0.228
Systolic Blood Pressure (SDS)	62	0.44 ± 1.20	104	0.70 ± 1.06	0.152	0.226
Diastolic Blood Pressure (SDS)	62	0.13 ± 0.93	104	0.47 ± 0.91	0.025	0.039
Alanine Aminotransferase (U/L)	62	18 (15-21)	105	41 (29-63)		

- SDS = standard deviation score (body mass index adjusted for age and gender[15]; systolic and diastolic blood pressures adjusted for age, gender and height[16]), ALT = alanine aminotransferase .
- Cutoffs for elevated alanine aminotransferase based on 95th percentile of healthy US adolescents (ALT ≥25.8 U/L for boys, ≥22.1 U/L for girls).[19]
- Values are presented as the number of subjects (percentage) for categorical variables, and means ± standard deviation or medians (interquartile ranges) for parametric and nonparametric continuous variables based on Shapiro-Wilk test and visual assessment of frequency distribution graphs, respectively. Univariate analysis was carried out using chi-square analysis, independent two-sample t-test and Wilcoxon rank sum tests for categorical, and parametric and nonparametric continuous variables, respectively. Logistic regression analysis included age and gender as covariates. Asian, Hispanic and Pacific Islander ethnic groups were assessed in relation to Whites for univariate and logistic regression analyses.

Table 2. Associations Between Alanine Aminotransferase and Study Parameters			
Study Parameter	**n**	**Correlation Coefficient* (*P*-value)**	**Regression Coefficient** (*P*-value)**
Age (years)	167	0.168 (0.030)	1.528 (0.022)
Body Mass Index (SDS)	166	0.070 (0.265)	1.288 (0.802)
Fasting Blood Glucose (mg/dL)	148	0.231 (0.005)	0.048 (0.336)
Hemoglobin A1c (%)	140	0.102 (0.231)	0.646 (0.687)
Total Cholesterol (mg/dL)	156	0.161 (0.045)	0.085 (0.218)
LDL-Cholesterol (mg/dL)	149	0.103 (0.209)	0.055 (0.527)
HDL-Cholesterol (mg/dL)	152	-0.077 (0.347)	-0.073 (0.801)
Triglycerides (mg/dL)	152	0.163 (0.044)	0.025 (0.314)
Systolic Blood Pressure (SDS)	166	0.155 (0.047)	1.931 (0.382)
Diastolic Blood Pressure (SDS)	166	0.249 (0.001)	6.200 (0.018)

SDS = standard deviation score (body mass index adjusted for age and gender;[15] systolic and diastolic blood pressures adjusted for age, gender and height[16])
*Spearman's rank correlation coefficient; **Linear regression analysis adjusted for age and gender.

Table 3. Proportion of Subjects with Features of Metabolic Syndrome and Elevated Alanine Aminotransferase		
Parameter	**Prevalence**	**Cutoff for Metabolic Syndrome**
Insulin Resistance	37 / 170 (22%)	Fasting blood glucose ≥110 mg/dL
Central Obesity	191 / 194 (98%)	BMI ≥95th percentile for age / gender
Low HDL-cholesterol	122 / 177 (69%)	HDL-cholesterol ≤40 mg/dL for boys, ≤50 mg/dL for girls
Hypertriglyceridemia	73 / 177 (41%)	Triglycerides ≥150 mg/dL
Hypertension	37 / 194 (19%)	SBP or DBP ≥95th percentile for age / gender / height
Elevated ALT*	105 / 167 (63%)	ALT ≥25.8 U/L for boys, ≥22.1 U/L for girls
Elevated ALT**	49 / 167 (29%)	ALT >51 U/L for boys, >31 U/L for girls

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, ALT = Alanine Aminotransferase
*95th percentile of healthy US adolescents;[19] **Clinical Laboratories of Hawai'i Upper Limit of Normal[21]

an ULN for serum ALT of 51 U/L for boys and 31 U/L for girls. In this study, subjects were classified as liver disease cases or controls based on the 95th percentile for healthy boys (<25.8 U/L) and girls (<22.1 U/L) in the United States.[21] Compared to the ULN for ALT used in many children's hospitals, this cutoff was found to provide higher sensitivity for chronic liver disease with only a slight loss of specificity.[21]

Data Analysis

Subject characteristics were summarized according to liver disease status as frequencies (percentage) for categorical variables, and means ± standard deviation or medians (interquartile range) for parametric and nonparametric continuous variables, respectively (Table 1). Continuous study variables were classified as parametric (systolic and diastolic blood pressure SDS) or nonparametric (age, BMI SDS, fasting blood glucose, hemoglobin A1c, total-, LDL- and HDL-cholesterol, serum triglycerides, alanine aminotransferase) based on Shapiro-Wilk test and visual assessment of frequency distribution graphs. Liver disease cases were compared to controls using chi-square analysis for categorical variables, independent two-sample t-test for parametric continuous variables, Wilcoxon rank sum test for nonparametric continuous variables, and logistic regression analysis for all variables, adjusting for age and gender (Table 1). The relationship between serum ALT and continuous variables was also analyzed using Spearman's rank correlation coefficient and linear regression analysis, adjusting for age and gender (Table 2). Due to the differences in the ULN for serum ALT, direct comparison of serum ALT between boys and girls was not conducted.[21] Prevalence of liver disease in relation to other features of metabolic syndrome was determined using the ULN of serum ALT from both Clinical Laboratories of Hawai'i (boys 51 U/L, girls 31 U/L), and the 95th percentiles for healthy children in the United States (boys <25.8 U/L, girls <22.1 U/L) (Table 3). Finally, subjects with and without serum ALT measurements available were compared across study parameters for sensitivity analysis. Statistical tests were carried out using SAS version 9.2, and graphs were created using Microsoft Excel for Mac 2011 v. 14.2.5.

Results

A total of 195 children (12.1 ± 3.6 years old, 103/195 [53%] boys, Table 1) were referred to the pediatric endocrinologist, and described as having metabolic syndrome during the initial consultation during this period. Data was available at the first appointment for over 80% of subjects for all study variables, including ALT (167/195 [86%], Table 1). The group that was missing ALT measurements was not significantly different ($\alpha < .05$) in any of the variables measured (data not shown).

Despite slightly higher thresholds, boys were more likely to have elevated ALT values indicative of liver disease (62/91 [68%]) than were girls (43/76 [57%]), although this difference was not statistically significant ($P = .123$, Table 1). Similarly, the presence of liver disease was not associated with age ($P = .369$, Table 1), although there was a slight positive correlation between serum ALT and age ($P = .030$, Table 2). Liver disease was associated with ethnicity ($P = .012$, Table 1). Compared to White children (33/52 [63%]), Pacific Islander children tended to be more likely (14/16 [88%], $P = .069$), and Hispanic children were less likely (7/20 [35%], $P = .029$) to have elevated ALTs suggestive of liver disease (Table 1). Multivariable analyses of study parameters adjusting for age and gender produced similar results (Tables 1 and 2).

The majority of patients was obese (BMI 95th percentile for age and gender; 191/194 [98.5%]), and had multiple comorbidities consistent with the diagnosis of metabolic syndrome (Table 3). Apart from obesity, the most common features of metabolic syndrome were low HDL-cholesterol (40 mg/dL boys, 50 mg/dL girls; 122/177 [69%]) and hypertriglyceridemia (150 mg/dL; 73/177 [41%]) (Table 3). Hypertension (systolic or diastolic blood pressure 95th percentile for age, gender and height) and fasting hyperglycemia (110 mg/dL) were less common, presenting in 37/194 (19%) and 37/170 (22%) of patients, respectively (Table 3). The majority of subjects had elevated serum ALT values suggestive of liver disease (boys 25.8 U/L, girls 22.1 U/L) was 105/167 (63%) (Table 3). Even at the more conservative ULN for serum ALT used locally by Clinical Laboratories of Hawai'i (boys 51 U/L, girls 31 U/L), an estimated 49/167 (29%) of subjects had liver disease, making it a relatively common complication in this population (Table 3).

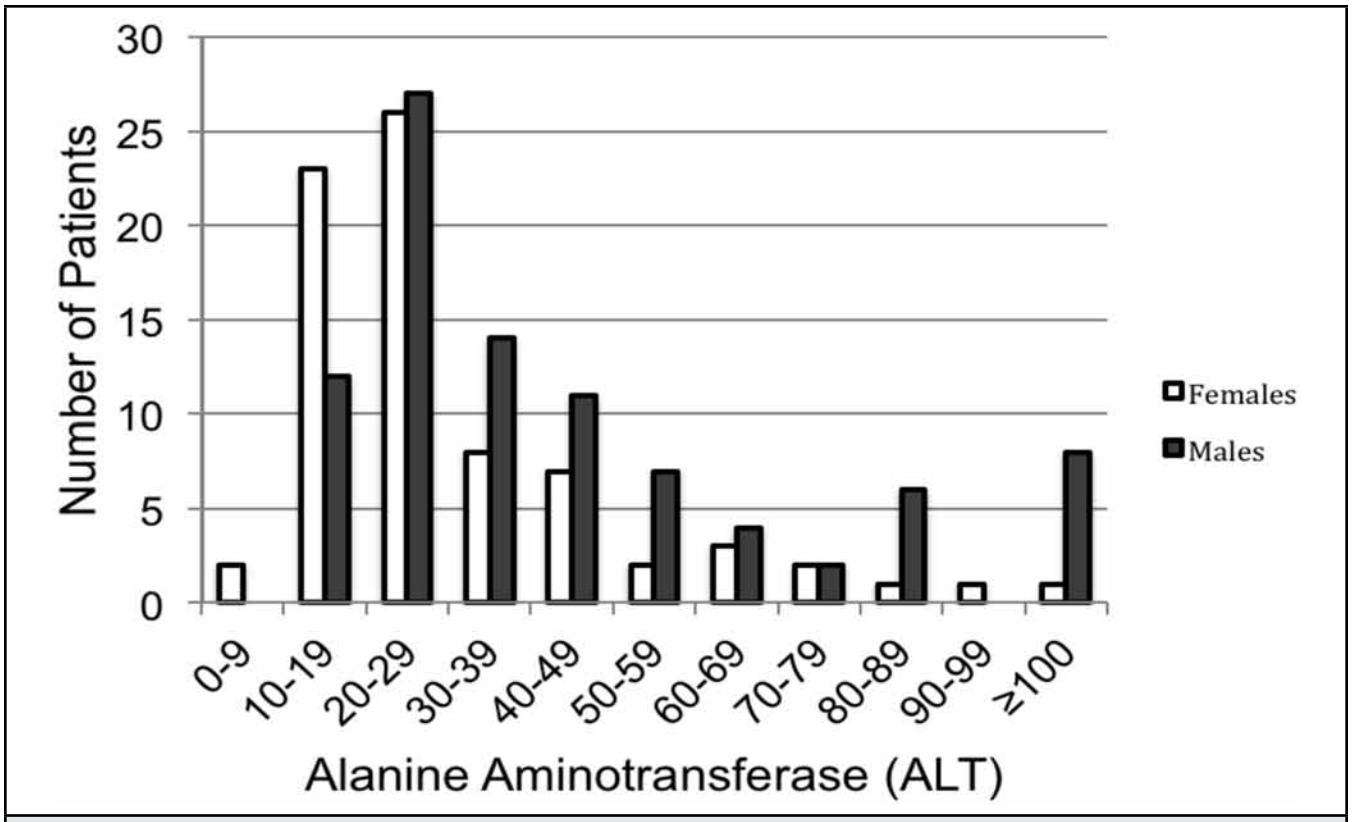

Figure 1. Frequency Distribution of Alanine Aminotransferase by Gender

The median (interquartile range) for serum ALT in boys was 35 U/L (22-56 U/L), and in girls was 24 U/L (17-38 U/L).

As expected, subjects with raised serum ALT values had higher BMIs (2.54 [2.27-2.75] SDS vs 2.35 [2.13-2.61] SDS, $P = .036$), and were worse for all disease factors measured, although this was only statistically significant for fasting blood glucose (96 [87-111] mg/dL vs 89 [83-97] mg/dL, $P = .007$), and diastolic blood pressure (0.47 ± 0.91 SDS vs 0.13 ± 0.93 SDS, $P = .025$) (Table 1). After adjusting for age and gender, fasting blood glucose was no longer associated with the ALT group ($P = .216$) (Table 1). When examined as a continuous variable, serum ALT was correlated with fasting blood glucose ($P = .005$), total cholesterol ($P = .045$), serum triglycerides ($P = .044$), and systolic and diastolic blood pressure ($P = .047$ and $P = .001$), but not BMI ($P = .265$) (Table 2). Only the association between serum ALT and diastolic blood pressure remained statistically significant when analyzed using linear regression controlling for age and gender ($P = .018$) (Table 2).

Discussion

The findings of this retrospective chart review confirm that elevated ALT is common in pediatric patients diagnosed with metabolic syndrome in Hawai'i. The thresholds for transaminasemia in this study were based on the 95th percentile of ALT in healthy adolescents from the National Health and Nutrition Examination Survey 1999-2006, which is lower than the ULN of ALT that are generally used in US children's hospitals.[21] The recommendation to adopt these lower cutoffs comes from the Screening ALT for Elevation in Today's Youth (SAFETY) study, which reported vast improvements in sensitivity for pediatric NAFLD in boys (32% to 80%) and girls (36% to 92%), while still maintaining moderate specificity of 79% and 85%, respectively.[21] The ULN used by Clinical Laboratories of Hawai'i is 51 U/L for boys and 31 U/L for girls, which still yields a prevalence of 29% for transaminasemia, making it a more common co-morbidity than either hypertension or fasting hyperglycemia. The relatively normal fasting glucose and hemoglobin A1c values are surprising given the high BMIs of children in this sample, although insulin resistance may have been disguised by insulin hypersecretion.[22] Unfortunately, other glycemic measurements such as serum insulin concentrations and oral glucose tolerance tests were not available to test this hypothesis.

There was a weak positive correlation between serum ALT and diastolic blood pressure, but not other obesity-related disease parameters. This study did not have the statistical power to assess these relationships, which may be partly related to the homogeneity of the sample. Supporting this, nearly every subject was obese. Additionally, fasting blood glucose may not be an appropriate indicator for assessing insulin resistance as it has been demonstrated previously to fail to detect significant relationships with ALT when present.[23] The association between

ALT and blood pressure may be related to elevated angiotensin II, which has been proposed to promote oxidative stress, inflammation, and fibrosis in the liver.[24]

The observation that serum ALT levels were correlated with age is consistent with other studies, which report increasing onset of NAFLD through the second decade of life.[13,25] Pediatric NAFLD has been found to be more common among boys and Hispanic adolescents, and least likely to present in Black adolescents.[4,12-13,23,25-26] In this sample, boys were not more likely to have liver disease, and children with Pacific Islander surnames tended to have higher ALT values. Hispanic ethnicity appeared to be protective in this sample, which was an unexpected finding. Importantly, ethnicity based on subject surname is likely to result in some misclassification, particularly in Hawai'i where almost one-quarter of the population is ethnically mixed.[14] The distinction between Hispanic and Filipino ethnicity based on surnames can be difficult given the early occupation of the Philippines by the Spanish.[27] Moreover, among Hispanics in Hawai'i, 29% are of Mexican ancestry and 36% are of Puerto Rican ancestry compared to 63% Mexican and 9% Puerto Rican of Hispanics nationally.[19] The differences in the distribution of NAFLD among adolescents by age, gender and ethnicity may be related to developmental changes with respect to sex hormones, visceral fat deposition, insulin sensitivity, and/or hepatic antioxidant defenses, although this has not been clearly elucidated.[28-30]

There are several limitations of this study that are noteworthy. Most patients did not have the testing necessary to rule out other causes of liver disease. However, given the high BMIs and age of the patients, NAFLD likely contributed to the majority of the observed prevalence of transaminasemia. Additionally, patients who were missing data may have been healthier, and therefore were not tested for co-morbidities, contributing to overestimation of the prevalence of these conditions in our sample. However, liver disease screening was not associated with any of the variables measured in sensitivity analysis. Finally, this is a pilot study based on a limited sampling frame and size. While it is able to provide preliminary data on liver disease on patients with metabolic syndrome, it did not have adequate power to evaluate relationships between most variables, and may not be representative of pediatric centers in other parts of Hawai'i.

Screening for NAFLD in this population occurred much more frequently than what has been reported in other pediatric hospitals, indicating a relatively good awareness of the condition locally in this clinical setting.[3] The prevalence of liver disease in this sample lend support to this practice. Future studies are needed to further evaluate the risk of NAFLD by ethnicity, and to evaluate the follow up patients that are found to have elevated ALT levels.

Disclosure Statement/Conflict of Interest

The research was partly supported by Award U54MD007584 from the National Center for Research Resources (NCRR), National Institutes of Health (NIH). The authors report no conflict of interest.

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References

1. Nigg C, Shor B, Tanaka CY, Hayes DK. Adolescent at-risk weight (overweight and obesity) prevalence in Hawai'i. *Hawaii Med J*. 2011;70(7,Suppl 1):4-9.
2. Ford ES, Li C. Defining the metabolic syndrome in children and adolescents: Will the real definition please stand up? *J Pediatr*. 2008;152(2):160-164.
3. D'Adamo E, Marcovecchio ML, Giannini C, et al. The possible role of liver steatosis in defining metabolic syndrome in prepubertal children. *Metabolism*. 2010;59:671-676.
4. Schwimmer JB, Pardee PE, Lavine JE, Blumkin AK, Cook S. Cardiovascular risk factors and the metabolic syndrome in pediatric nonalcoholic fatty liver disease. *Circulation*. 2008;118:277-283.
5. Manco M, Marcellini M, DeVito R, Comparcola D, Sartorelli MR, Nobili V. Metabolic syndrome and liver histology in paediatric non-alcoholic steatohepatitis. *Int J Obes*. 2008;32:381-387.
6. Kistler KD, Molleston J, Unalp A, et al. Symptoms and quality of life in obese children and adolescents with non-alcoholic fatty liver disease. *Aliment Pharmacol Ther*. 2010;31:396-406.
7. Schwimmer JB, Behling C, Newbury R, et al. Histopathology of pediatric nonalcoholic fatty liver disease. *Hepatology*. 2005;42:641-649.
8. Carter-Kent C, Yerian LM, Brunt EM, et al. Nonalcoholic steatohepatitis in children: A multicenter clinicopathological study. *Hepatology*. 2009;50:1113-1120.
9. Ko JS, Yoon JM, Yang HR, et al. Clinical and histological features of nonalcoholic fatty liver disease in children. *Dig Dis Sci*. 2009;54:2225-2230.
10. Nobili V, Marcellini M, DeVito R, et al. NAFLD in children: A prospective clinical-pathological study and effect of lifestyle advice. *Hepatology*. 2006;44:458-465.
11. Riley MR, Bass NM, Rosenthal P, Merrman R. Underdiagnosis of pediatric obesity and underscreening for fatty liver disease and metabolic syndrome by pediatricians and pediatric subspecialists. *J Pediatr*. 2005;147:839-842.
12. Graham RC, Burke A, Stettler N. Ethnic and sex differences in the association between metabolic syndrome and suspected nonalcoholic fatty liver disease in a nationally representative sample of US adolescents. *JPGN*. 2009;49:442-449.
13. Schwimmer JB, Deutsch R, Kahen T, Lavine JE, Stanley C, Behling C. Prevalence of fatty liver in children and adolescents. *Pediatrics*. 2006;118:1388-1393.
14. Kaneshiro B, Geling O, Gellert K, Millar L. The challenges of collecting data on race and ethnicity in a diverse, multiethnic state. *Hawaii Med J*. 2011;70(8):168-171.
15. Center for Disease Control and Prevention (CDC). Percentile data files with LMS values. 2009. Accessed March 16, 2011 at http://www.cdc.gov/growthcharts/percentile_data_files.htm.
16. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*. 2004;114(Suppl. 4th Report):555-576.
17. Kolonel LN, Henderson BE, Hankin JH, et al. A multiethnic cohort in Hawaii and Los Angeles: Baseline characteristics. *Am J Epidemiol*. 2000;151:346-357.
18. National Institutes of Health. 2001. NIH policy on reporting race and ethnicity data: Subjects in clinical research. Accessed December 13, 2012 from http://grants.nih.gov/grants/guide/notice-files/not-od-01-053.html.
19. US Census Bureau. 2010 census interactive population search. Accessed July 16, 2012 at http://www.census.gov/2010census/popmap/ipmtext.php?fl=15.
20. Neuschwander-Tetri BA, Unalp A, Creer MH, Nonalcoholic Steatohepatitis Clinical Research Network. Influence of local reference populations on upper limits of normal for serum alanine aminotransferase levels. *Arch Intern Med*. 2008;168(6):663-666.
21. Schwimmer JB, Dunn W, Norman GJ,et al. SAFETY study: Alanine aminotransferase cutoff values are set too high for reliable detection of pediatric chronic liver disease. *Gastroenterology*. 2010;138:1357-1364.
22. Ludwig DS, Ebbeling CB. Type 2 diabetes mellitus in children: Primary care and public health considerations. *JAMA*. 2001;286(12):1427-1430.
23. Burgert TS, Taksali SE, Dziura J, et al. Alanine aminotransferase levels and fatty liver in childhood obesity: Associations with insulin resistance, adiponectin, and visceral fat. *J Clin Endocrinol Metab*. 2006;91:4287-4294.
24. Moreno M, Bataller R. Cytokines and renin-angiotensin system signaling in hepatic fibrosis. *Clin Liver Dis*. 2008;12:825-852.
25. Fraser A, Longnecker MP, Lawlor DA. Prevalence of elevated alanine-aminotransferase (ALT) among US adolescents and associated factors: NHANES 1999-2004. *Gastroenterology*. 2007;133(6):1814-1820.
26. Schwimmer JB, McGreal N, Deutsch R, Finegold MJ, Lavine JE. Influence of gender, race, and ethnicity on suspected fatty liver in obese adolescents. *Pediatrics*. 2005;115:e561-e565.
27. Fernandez LH. *A brief history of the Philippines*. 1919. Ginn and company. Boston: MA.
28. Miyagi SJ, Brown IW, Chock JML, Collier AC. Developmental changes in hepatic antioxidant capacity are age- and sex-dependent. *J Pharmacol Sci*. 2009;111(4):440-445.
29. Goran MI, Gower BA. Longitudinal study of pubertal insulin resistance. *Diabetes*. 2001;50:2444-2450.
30. Novotny R, Daida YG, Grove JS, Marchand LL, Vijayadeva V. Asian adolescents have a higher truck:peripheral fat ratio than whites. *J Nutr*. 2006;136(3):642-647.

Ultrasound Education in Obstetrics and Gynecology: Hawai'i Experience

Pai-Jong Stacy Tsai MD, MPH; Shelby Wong MEd; and Ivica Zalud MD, PhD

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.

The increased speed to acquire new medical knowledge, insights, and research is demanding, especially in arranging ways that are innovative, creative, effective, concise, and efficient. Organized, lifelong learning is becoming necessary and mandated by medical boards in order to maintain medical licensure and board certifications. The American Board of Obstetrics and Gynecology (ABOG) has implemented learning principles and annual re-certification process. An example is ultrasound education. In the last century, ultrasound has changed the practice of medicine. This is even more applicable to the field of obstetrics and gynecology. More than any other diagnostic modality, ultrasound has made dramatic imprints on diagnosis of pregnancy, fetal wellbeing, detection of anomalies and aneuploidy, fetal surgery, and intrauterine interventions, and early detection of pelvic masses and uterine anomalies. More than ever ultrasound education is needed to provide health care professionals the proper environment to make sound clinical judgments, accurate diagnosis, and management plans. Only then can contemporary OB/GYN physicians think and act confidently and effectively for the benefit of patients and the unborn fetuses. This is done with the strong belief that ultrasound education is driven by innovative thinking, adaptability, and collaboration.

With the rapid advances in medical technology, ultrasound education now faces challenges on the "best" techniques to train medical students, residents, and fellows. Medical specialties across the United States have made it a requirement to obtain formal imaging training during residencies and fellowships. In obstetrics and gynecology, the use of ultrasound in diagnosis and management has become a necessity in everyday practice. It is seen as a "virtual light" into the pelvis, making the "miracle of life" visible as early as 6 weeks of gestation. Formal training provides practical skills in performing and interpreting ultrasounds. The physician is also provided with essential knowledge and training in obstetric ultrasound safety, which was previously lacking in the training of obstetrics residents and Maternal-Fetal Medicine fellows.[1] A successful ultrasound curriculum was implemented at Madigan Army Medical Center and was shown to improve learning performance in obstetric residents.[2] The John A. Burns School of Medicine (JABSOM), the Department of Obstetrics, Gynecology (OB/GYN), and Women's Health implemented a similar form of ultrasound curriculum for residents and fellows.

Medical Student Education

Currently, there are no formal requirements for ultrasound education for medical students. At JABSOM, University of Hawai'i, medical students on their third year OB/GYN rotation are exposed to basics in ultrasound. They observe residents preforming ultrasound examinations in labor and delivery suite, clinics, and emergency room. An additional opportunity for the medical student is to observe ultrasound examination performed at the Fetal Diagnostic Center, Kapi'olani Medical Center for Women and Children.

Residency Education

The OB/GYN residency ultrasound curriculum at JABSOM was designed to fulfill the education objectives established by the Council on Resident Education in Obstetrics and Gynecology (CREOG) and American Institute of Ultrasound Medicine (AIUM). OB/GYN residents undergo one month of formal obstetric ultrasound education in their first year and one month of formal gynecology ultrasound education in their fourth year. In addition, there is ultrasound exposure throughout the entire residency program (eg, labor and delivery rotation, emergency room, residents clinics). The ultrasound curriculum consists of both didactic and hands-on training. Registered sonographers who are highly experienced and specialized in OB/GYN ultrasound teach ultrasound techniques, optimization of images and instrumentation, anatomical survey, and biometry. Special emphasis is on the residents' ability to properly scan patients by using different ultrasound techniques (transabdominal and transvaginal ultrasound, Doppler ultrasound, 3D/4D ultrasound), report the findings and establish diagnosis and management plans. After completing the obstetrical ultrasound curriculum, the resident is expected to demonstrate an investigatory and analytic thinking approach to clinical situations related to OB/GYN ultrasound. They must also be able to identify normal fetal ultrasound findings, abnormal fetal conditions/anomalies, and maternal complications in pregnancy. They are expected to develop clinical proficiency in performing and interpreting basic obstetrical ultrasound exams. The gynecologic ultrasound curriculum requires the resident to be able to perform and interpret transvaginal and abdominal ultrasound, including sonohysterography for gynecologic patients. They should be able to identify normal and abnormal ultrasound patterns as-

sociated with organs and structures of the female reproductive system. Upon surveying the previous graduates of the residency program, the majority felt that the formal curriculum provided adequate training.

Maternal-Fetal Medicine Fellowship Education

In 2009, JABSOM's Department of Obstetrics, Gynecology, and Women's Health initiated a fellowship in Maternal-Fetal Medicine (MFM). A 2008 survey of MFM physicians found that the majority of time in practice was spent in ultrasonography.[3] To prepare fellows for the ultrasonography aspect of MFM practice, obstetric ultrasound training was implemented following the guidelines set forth by the American Board of Obstetrics and Gynecology (ABOG), the accrediting body for nationwide fellowship programs in Maternal-Fetal Medicine. During the three-year fellowship program, fellows have five one-month dedicated rotations in MFM Imaging. During these periods, fellows focus on hands-on scanning, image interpretation, patient counseling, and exposure to advanced imaging modalities such as Doppler, fetal echocardiogram, 3D/4D ultrasound, and invasive ultrasound guided procedures, including chorionic villous sampling (CVS), percutaneous blood sampling (PUBS), and amniocentesis. In addition, the imaging curriculum for fellows requires them to show competency in performing detailed obstetric ultrasound examinations, interpreting images and identifying anomalies, and counseling patients about risks, benefits, and alternatives of various invasive fetal testing. If an anomaly is found, they must be able to provide counseling on management options and discuss prognosis. Fellows also have the ability to gear their learning toward a specific facet of ultrasound that is of particular interest to them. The program offers faculty with the establishment of additional expertise in CVS, fetal echocardiogram, as well as gynecologic ultrasound.

Continuing Medical Education

Continuing Medical Education (CME) is a large component of ultrasound education for physicians who trained prior to the institution of formal ultrasound training during their residency. Additionally, ultrasound trained specialists and sonographers need to keep their knowledge and skills continuously updated and challenged with rapidly developing techniques in ultrasound and genetics. In conjunction with the Ian Donald Interuniversity School of Medical Ultrasound — Hawai'i Branch, the Department of Obstetrics, Gynecology, and Women's Health at JABSOM was first to bring CME in OB/GYN ultrasound to Hawai'i. Since 2005, the department has held the "Contemporary OB/GYN Ultrasound: Recent Advances and Clinical Practice" conference biannually. The conference has grown from a modest one-day course held at Kapi'olani Medical Center for Women and Children to a two-day conference held at the Ala Moana Hotel with nationally and internationally renowned speakers and participants. The goals of the conference are to effectively educate the OB/GYN community in Hawai'i on the recent innovations and trends in obstetrics and gynecologic ultrasound as well as to provide a foundation for those physicians who perform office ultrasounds.

By providing high quality CME in OB/GYN ultrasound in Hawai'i, local physicians, sonographers and allied health care professionals are given the option to attend a high quality, focused conference and earn their CME credits without having to travel out of state and having to close their practices. In addition, the conferences accommodate medical students, residents, and fellows to gain ultrasound education in a high quality forum to discuss different clinical scenarios and diagnostic challenges. Interactive sections with audience participation and discussions are especially well received.

The next OB/GYN ultrasound conference will be held on September 13th to 14th, 2013. Conference information can be found at <www.ultrasoundhawaii.org>.

The Future

Formalized ultrasound education should be considered in the curriculum for medical students. Currently, there are only two US medical schools that have developed a four-year ultrasound curriculum.[4] At the Ohio State University College of Medicine, a formal ultrasound training program that focuses on ultrasound physics, terminology, knobology, and focused protocols has been in place since 2000. Beginning of 2005, an advanced ultrasound education that includes imaging interpretation was added.[4] Their students have graduated from medical school with advanced knowledge and skills in ultrasound that have helped them excel in their careers.

New technology is accompanied by new procedures. Residents in OB/GYN are required by CREOG to understand and perform third trimester amniocentesis under ultrasound guidance. Fellows in MFM are required by ABOG to perform genetic amniocentesis, CVS, and percutaneous umbilical blood sampling (PUBS) under ultrasound guidance. Simulation trainings have evolved in the past few years to fulfill these requirements. Simulation models can range from simple self-made models to sophisticated machines. For example, a self-made amniocentesis training model has been described to be made out of an exam glove, condom, tap water, and needle.[5] On the contrary, a commercially built simulation model contains a realistic pelvic anatomy made from materials that match the acoustic characteristics of real human tissue. These models are constantly improving to meet training needs.

As medical technology becomes more sophisticated, new medical training will evolve. The medical educators' responsibility is to ensure that new technology will be used properly to improve and maintain the health of patients.

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References

1. Houston LE, Allsworth J, Macones GA. Ultrasound is safe... right?: resident and maternal-fetal medicine fellow knowledge regarding obstetric ultrasound safety. *J Ultrasound Med.* Jan 2011;30(1):21-27.
2. Calhoun BC, Hume RF. Integrated Obstetric Curriculum for Obstetrics and Gynecology Residency, Radiology Residency and Maternal-Fetal Medicine Fellowship program at an accredited American Institute of Ultrasound in Medicine Diagnostic Ultrasound Center. *Ultrasound Obstet Gynecol.* Jul 2000;16(1):68-71.
3. Wing DA, Quilligan EJ. Fellowship Training: The Ever-Changing Subspecialty of Maternal–Fetal Medicine. *Obstet Gynecol.* Dec 2008;112(6):1288-1293.
4. Bahner DP, Royall NA. Advanced ultrasound training for fourth-year medical students: a novel training program at the ohio state university college of medicine. *Acad Med.* Feb 2013;88(2):206-213.
5. Karasahin E, Alanbay I, Ercan M, Yenen MC, Dede M, Baser I. Simple, cheap, practical and efficient amniocentesis training model made with materials found in every obstetrics clinic. *Prenat Diagn.* Nov 2009;29(11):1069-1070.

Classified Notice

"Caring for Our Kupuna: Balancing Human Dignity and Economics"
August 9, 2013, 8-5 PM
Sheraton Waikiki Hotel

http://www.stfrancishawaii.org/mission-services/ethics/international-bioethics-conference

UPCOMING CME EVENTS

Interested in having your upcoming CME Conference listed? Please contact Brenda Wong at (808) 536-7702 x103 for information.

Date	Sponsor	Location	Meeting Topic	Contact
June 2013				
6/29-7/5	Children's Hospital Los Angeles Medical Group	Hyatt Regency Maui, Lahaina	Pediatrics in the Islands…Clinical Pearls 2013	https://s08.123signup.com/servlet/SignUp?P=15329551911424919300&PG=1532955182300
6/30-7/5	UC San Francisco School of Medicine	Hapuna Beach Prince Hotel, Mauna Kea, Big Island	Essentials of Women's Health: An Integrated Approach to Primary Care & Office Gynecology	http://www.ucsfcme.com/2014/brochure/MDM14M01.02STDC.pdf
July 2013				
7/21-7/25	Orthopaedic Surgery Kaiser Permanente Hawai'i	Grand Wailea Resort & Spa, Maui	21st Annual Update in Orthopaedic Surgery Conference	http://cmxtravel.com/kpor/2013/default.htm

Innovative Readiness Training & Tropic Care Kaua‘i 2012

Dileep G. Bal MD; Toni Torres BSN; Thomas Noyes AB; John Hunt MFA;
Keith Y. Yamamoto MPA; and Dennis M. Esaki BS

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 Rajan MPH from the Hawai'i Department of Health.

Tropic Care Kaua‘i 2012 was a Department of Defense Innovative Readiness Training (“IRT”) deployment that took place on Kaua‘i for a two week period in February/March 2012. The main purpose of the operation was to provide nearly 400 military reservists from around the country with real-world rapid deployment training they could not otherwise get during a typical Annual Tour and the opportunity to employ their technical/professional skills in a “field” setting similar to what they might expect during a post-disaster medical response.

While the primary mission of an IRT deployment is Joint/multi-service deployment training, a significant secondary benefit of each mission is the provision of free Medical, Dental, Veterinary, and Optometry operation health services to a variety of underserved American populations located in remote areas throughout the United States and US territories.[1] In past years, the IRT program has deployed military medical reserve personnel to several states and territories including Alabama, Alaska, Arizona, California, Guam, Hawai‘i, Minnesota, Montana, New Mexico, North Dakota, Oregon, South Dakota, and the Virgin Islands to complete medical and civil engineering projects for the public benefit.

In its continuing effort to improve the island’s public health, the State of Hawai‘i Department of Health’s Kaua‘i District Health Office,[2] collaborated with Governor Abercrombie’s Kaua‘i Office on an application to the Pentagon to hold the 2012 exercises in Kaua‘i for the benefit of the residents. Dr. Dileep G. Bal, Kaua‘i District Health Officer, designated the Kaua‘i District Health Office Nursing Supervisor, Ms. Toni Torres, as the lead coordinator of this effort.

Many Kaua‘i residents who lack medical insurance have deferred basic medical attention for many years because they cannot afford to be see a doctor, dentist, optometrist, or mental health professional unless there is an acute health issue. The entire island of Kaua‘i is a US Public Health Service and Governor designated medically underserved area.[3] Tropic Care Kaua‘i 2012 took place on Kaua‘i starting February 28, 2012 and concluded on March 9, 2012. Active Duty, Reserve, and National Guard members of the US Armed Forces arrived a few days prior to commencing medical services to set up logistics and staffing for the clinic sites and to inventory and organize needed equipment. By providing free dental, optometric, mental health, and primary care visits and in-service and health professional trainings, this operation addressed a vast array of serious unmet health care needs (Table 1).

Table 1. Selected list of services provided through Tropic Care Kaua‘i 2012.

Behavioral assessments
Dentistry
Educational sessions/in service training on: • Continuing Medical Education (CME) for local physicians on the special needs of veterans • CPR • Nutrition • Physical activity • Asthma
Family practice
Medication review
Nutrition
Optometry (eye exams and supplying eye glasses)
Physical examinations
Primary medicine
Provision of some medications (pharmacy)

This IRT deployment simultaneously fulfilled each participating Guardsman/Reservists’ two-week annual training requirement to achieve the Pentagon’s stated objective to train part-time soldiers to deploy to remote locations, and provided much needed health care to Kaua‘i residents. The Tropic Care Kaua‘i 2012 mission challenged the Armed Forces to plan and implement a rapid mobilization to a distant and culturally unfamiliar area—skills that must be ready without warning in order for our nation’s Reserve Component forces to function as intended in the event of a homeland emergency or other contingency.

The military personnel were housed at the Kapa‘a Armory and Hanapepe Armory where they walked or were transported to their clinic sites based upon the distance and weather. The three public clinics located across the island used for direct services were (Figure 1):

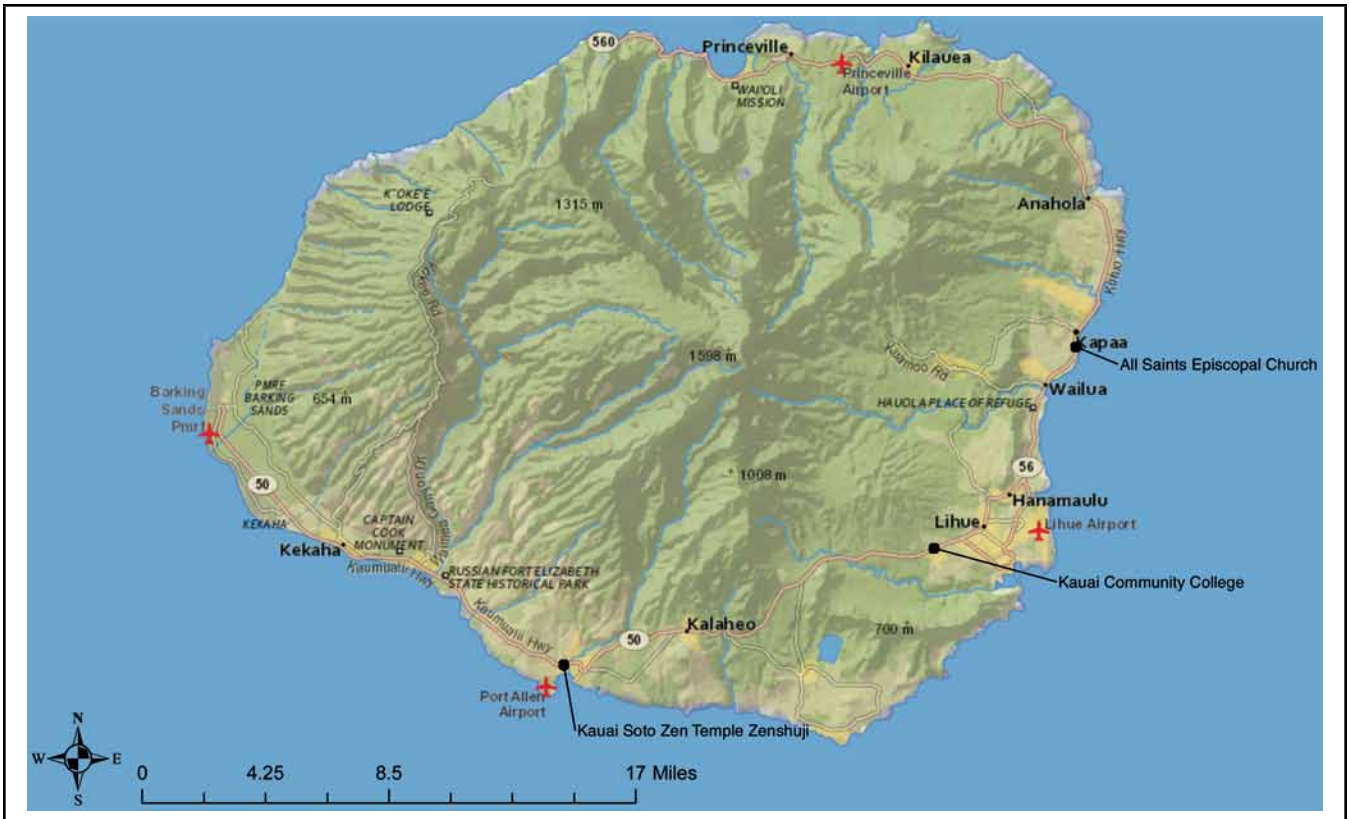

Figure 1. Location of Clinic Sites in Kauai County, Tropic Care Kaua'i 2012.

- All Saints Episcopal Church, Kapaa
- Kaua'i Community College, Puhi,
- Kaua'i Soto Zen Temple Zenshuji, Hanapepe

While the Kaua'i District Health Office was the principal coordinating agency on this exercise, multiple federal and local partners including county civil authorities and a wide range of community based volunteers were involved in its successful execution. Federal Coordinating Organizations included the Army, Navy, and Air National Guard. State collaborators included the Governor's Office, Hawai'i National Guard, Department of Education, and the Kaua'i Community College, among others. The County of Kaua'i was a major collaborator and Mayor Carvalho graciously provided free, universal island-wide bus service for the duration of the IRT stay. All visitors to the island were also (incidental) beneficiaries of Mayor Carvalho's generous support of the IRT initiative. The private and non-profit sectors on Kaua'i were major partners also including the Buddhist temples (Hongwanjis), churches, hospitals, and county organizations like the Lions Club and Salvation Army.

While on Kaua'i, military licensed caregivers and their support staffs provided services to over 10,000 patients free of charge. This included about 2,200 medical, about 3,000 dental, and about 5,000 optometry patients. Participation was publicized throughout the island via print media, radio announcements, and the Internet and open to everyone. The distribution of services was based on consumer need and availability of health professionals. Dental services were provided both in mobile chairs and in chairs located in existing dental offices (Figure 2). There was a great need for optometric services as demonstrated by the 3,570 pairs of eyeglasses that were custom fabricated. Other services included physical therapy, psychological counseling, and dietary/nutritional counseling, among others.

Figure 2. Capt. Anthony Batko, Operational Hospital Support Unit, Bethesda, MD, and Senior Airman Amanda Bean, 110 Medical Group, Michigan Air National Guard provide dental care to a Kaua'i resident.

A "floating" multi-specialty team rotated between the Eastside (Kapa'a) and the Westside (Hanapepe) to enhance members' ability to provide specialized services support under remote, challenging and austere conditions. A "fortunate" event for military disaster response training under adverse conditions but challenging for our island residents, a massive storm hit Kaua'i during the IRT mission. These teams worked with local health workers, municipal authorities, and citizen volunteers to assist in scheduling and providing local and cross-cultural context to the operation. Specific specialty and allied health services requested during the mission were nutrition and weight management counseling, behavioral health group familiarization sessions on substance abuse, family and grief counseling. All of these were necessary and well received.

The aggregate dollar value for the medical services rendered was estimated to be in excess of $7 million, showing significant leverage for a program with just under a $500,000 budget. The dollar value of medical benefits to Kaua'i does not include the economic boost to local businesses from mission-related and individual visitor-industry related expenditures by the deployed Armed Forces personnel.

Once the Kaua'i District Health Office core group understood that the military was willing and able to undertake non-medical missions (including engineering missions), they facilitated contact with the Mayor, county department heads, and private groups like the Habitat for Humanity on Kaua'i. More of these types of projects have been planned with the intent to implement them in 2013 as major joint-funded infrastructure efforts. For instance, the County of Kaua'i, Department of Public Works (County DPW) is engaged in improving an existing pedestrian way to provide an Americans with Disabilities Act (ADA) compliant shared use path for pedestrians, bicyclists, and other users from Kūhi'ō Highway to Gore Park in Kapa'a, a distance of approximately a half mile (2,570 feet). This project, referred to as the "Lydgate Park-Kapa'a Bike/Pedestrian Path Kawaihau Spur" (Kawaihau Spur), is part of a longer, continuous pathway (Ke Ala Hele Makalae) that will ultimately travel along the east side of Kaua'i from Nāwiliwili in the south to Anahola in the north.

An elevated boardwalk portion of the Kawaihau Spur is required to provide a safe and ADA compliant shared-use path and will be built with IRT personnel assigned to Kaua'i for that purpose. The balance of the Kawaihau Spur is being built as a separate project by a contractor paid with Federal Highway Administration (FHWA) funds.

Furthermore, during the Tropic Care 2012 deployment, in addition to providing base operating support, eg, set-up and maintenance of mobile shave/shower units, a 20-member Civil Engineering (CE) Team augmented the core IRT mission objectives by carrying out minor construction and repair projects in Kapa'a and Hanapepe, Hawai'i. The team helped repair the deteriorating roof of the Kaua'i Habitat for Humanity Store and warehouse in Eleele, Hawai'i, and built handicap access ramps at facilities in and around Lihue and Kapa'a, Hawai'i. Additional minor construction and repair projects were executed during Tropic Care – Kaua'i 2012.

To follow up on this entire effort, the Kaua'i District Health Office (KDHO) core group elected to expand this program to other islands. The Kaua'i DOH team already intends to continue submitting annual applications to the Pentagon on behalf of one or more islands every year. Based upon their priorities and the availability of federal funds, it is our hope to have an IRT presence somewhere in Hawai'i every year. As a consequence of the successful outcomes of the IRT initiative on Kaua'i, the efficient execution of the mission by the military and their local collaborators and the obvious community needs (because of the paucity of local resources and services), our hope is that our military partners will continue to plan annual missions in Hawai'i. The IRT Program Office in the Office of the Assistant Secretary of Defense for Health Affairs at the Pentagon has also requested Maui's mayor and his staff discuss with the Kaua'i DOH team how they can optimize a proposed IRT mission planned for Maui in 2013. The KDHO is looking forward to working with the Maui Mayor on this proposed initiative.

The obvious conclusions from this entire experience are: First, our public health *ohana* need to look further and further afield from our usual funding and program sources for the wherewithal to meet our populations' needs in an ever evolving and innovative fashion. Second, we need to be diligent in *actively* seeking and applying for these programs using the somewhat different requirements of these new partners. Third, to better meet the needs of our island communities we must direct resources to our county departments and other agencies that are unaware of and not accustomed to soliciting these funds from diverse federal sources. Finally, in an enterprise such as this we need to capitalize on our unique location and offerings and do a superb job as collaborators in order to encourage repeat projects and even entice new ones.

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References

1. Department of Defense Innovative Readiness Training. http://irt.defense.gov/projects.html.
2. Kaua'i District Health Office: http://hawaii.gov/health//neighbor/kauai/index.html.
3. Family Health Services Division. Hawai'i Primary Care Needs Assessment Data Book. 2012. Hawai'i Department of Health.

THE WEATHERVANE

RUSSELL T. STODD MD; CONTRIBUTING EDITOR

THIS NEO-NAZI DESERVES THE "ARGO" RESPONSE.

In Flint, Michigan, a nurse had been working at Hurley Medical Center for more than 20 years. She was abruptly removed from her position in the neo-natal intensive care nursery by the head nurse and reassigned. A swastika-tattooed father said he did not want any African American person caring for his newborn daughter. The nurse was offended and shocked in disbelief. She brought a lawsuit against the hospital for egregiously discriminating against her based solely on her race. The evidence appears overwhelming which will make the hospital subject to severe penalties, not to mention the civil suit.

I WAS ONLY TRYING TO MAKE A SMILE.

A report from the University of California San Francisco (UCSF) surveyed emergency room visits from 2002 to 2010. A striking number of patients were seen with injuries sustained during removing, or otherwise tailoring, pubic hair. Data collected by the National Electronic Injury Surveillance System (NEISS) found that, that frequency is on the rise with 2500 ER visits in 2010 alone. Damages produced were burns, cuts, gashes, slashes, and rashes. Tools used were knives, scissors, razors, and hot wax. A false assumption would be that this is largely a feminine event, but 43% of admissions were males. UCSF clinical researcher, Alison Glass, found that 3% of all genito-urinary injuries were related to grooming practices. Seems likely that some entrepreneur might open a salon in the mall and offer safe, skilled pubic coifs. Imagine what could be designed for Valentines Day. Christmas, Easter, or July 4th.

LET'S HEAR IT FOR CENTERS OF EXCELLENCE (COES) RAH, RAH, SIS-BOOM-BALONEY!

In 2006 the Centers for Medicare & Medicaid Services (CMS) issued a national decision that limited coverage of weight loss surgery to COEs. The centers are accredited by either the American College of Surgeons (ACS) or the American Society for Metabolic and Bariatric Surgery (ASMBS). A report published in the Journal of the American Medical Association (JAMA) covered a retrospective longitudinal study from 2004 to 2009 using hospital discharge data from 12 states documenting bariatric surgery. Changes in outcomes among 464 Medicare patients were evaluated. The team conclusion is that there was no significant difference in the rates of complications and reoperation before vs. after the CMS policy of restricting coverage to COEs. The authors suggest that CMS should reconsider the policy.

SOMETIMES "STATE OF THE ART" ISN'T.

It is vital to establish an airway for patients who suffer a heart attack away from a hospital. A study from Japan covered 649,654 consecutive adult patients who had an out-of-hospital myocardial infarction. Emergency responders used bag-valve-mask ventilation in 57% of patients and advanced technique with intubation or supra-glottis device with 43%. Contrary to expectations, patients who received bag-valve-mask ventilation had a higher rate of survival at one month and more favorable neurologic outcome compared with those treated with advanced airway management. Lead author, Kohei Hasegawa MD, at Harvard Medical School, plans further study. He observed that intubation can be difficult and challenging with some patients, causing delays, tube misplacement or tissue damage.

THE EYES ARE THE WINDOWS OF THE SOUL, AND PERHAPS THE BRAIN.

A fascinating report in the Journal of Biological Psychiatry by a team from University of Abereen in Scotland shows a method for diagnosing schizophrenia. Where general medical practice has thousands of tests and instruments available, until now, psychiatry has lacked any objective diagnostic test for psychiatric spectrum illnesses. Philip Benson PhD, and his group in Scotland reported that a few simple eye movement tests are used to diagnose schizophrenia with near total accuracy (98.3%). The eye movement tests are cheap and can be easily administered in a hospital or clinic by a trained technician. The tests include horizontal and Lisajous pursuit, visual scan-path and fixation stability. Schizophrenics showed different results from control subjects on almost all of the eye motion tests.

GET OFF YOUR BUTTS AND WE MIGHT HIRE YOU.

The University of Pennsylvania Medical System will no longer hire smokers. A job applicant must be smoke-free for six months before consideration. Penn is not alone. Hospitals and health systems in at least nine other states have similar restrictions. Penn justifies this action by stating that smoking employees cost $3,391 more per year with lost time and health care. Morover, taking smoke-breaks may be disruptive, and returning to work smelling of tobacco smoke may be irritating to patients and other staff members. Where does this controlling type regulation lead? What about obese staff, or biking employees who won't wear helmets? How far will they go with "Thou shalt not?"

THE OLD SYSTEM OF HAVING A BABY WAS BETTER — NO DNA, NO SPERM AUCTION, NO CRYOGENICS.

In 2002 a man in Louisiana had a child with his girl friend. Later, he collected a sperm specimen for cryogenic storage with a Texas fertilization clinic before having a vasectomy. Both partners signed a statement that the sperm could only be used by the woman. In 2006 they parted company, and the man began dating a younger woman. In 2008, couple number two went to the fertility clinic to discuss her pregnancy options. She was aware that he had sperm stored in the nearby clinic. After an on-again off-again five-year romance, he broke off the relationship. According to court documents, in November 2011 girl friend number two walked into the sperm bank and asked for the stored sperm. Two vials were delivered in a brown paper bag, apparently with no questions asked. She promptly went to the fertility clinic, was inseminated and subsequently delivered a baby boy. The man has brought a suit for unspecified damages against the clinic for releasing his sperm. His attorney stated, "More ID is required of an 18 year-old buying a pack of cigarettes." A trial is scheduled in Houston in April.

ARE DRUG TESTS UNREASONABLE SEARCHES? YES, SAYS THE COURT.

In May,2011 Florida enacted a statute which required drug testing for welfare applicants. The law was not struck down, but 11th US Court of Appeals ruled that Florida hadn't shown a "special need" that justified suspending the Fourth Amendment protections against unreasonable searches. Florida Governor Rick Scott called the ruling "disturbing" and that Florida would appeal it to the US Supreme Court. "Drug use by anyone with children looking for a job is totally destructive." Of course in today's occupational market, no one can get hired without first passing a drug test. Go figure.

ADDENDA

- At over 3200 feet, Angel Falls in Venezuela is the tallest waterfall in the world. It is named after a US pilot, Jimmie Angel.
- The average American child takes its first trip to the mall at age 2 months.
- Sign at the computer store, "Your crap is already obsolete."
- Don't socialize with any couple who own "his and hers" rectal thermometers.
- We are all just batteries waiting to be included.

ALOHA AND KEEP THE FAITH rts

(Editorial comment is strictly that of the writer.)

Partners in Sustainable Health Care

HMSA's objective in implementing the patient-centered medical home (PCMH) model is to build a sustainable health care system for Hawaii. In collaboration with key stakeholders, HMSA is encouraging its members to select and use a PCP.

If you would like to participate in HMSA's PCMH program, please call PCMH Practice Transformation Manager Paul McFall at 948-6214 on Oahu.

We strive every day to ensure that our members have access to quality health care delivered by the state's largest network of providers. Through collaboration with providers and provider organizations, we are able to create opportunities for improvement in the quality of care provided to our members. We appreciate your work effort and look forward to a bright future for Hawaii's health care system and the health of our members.

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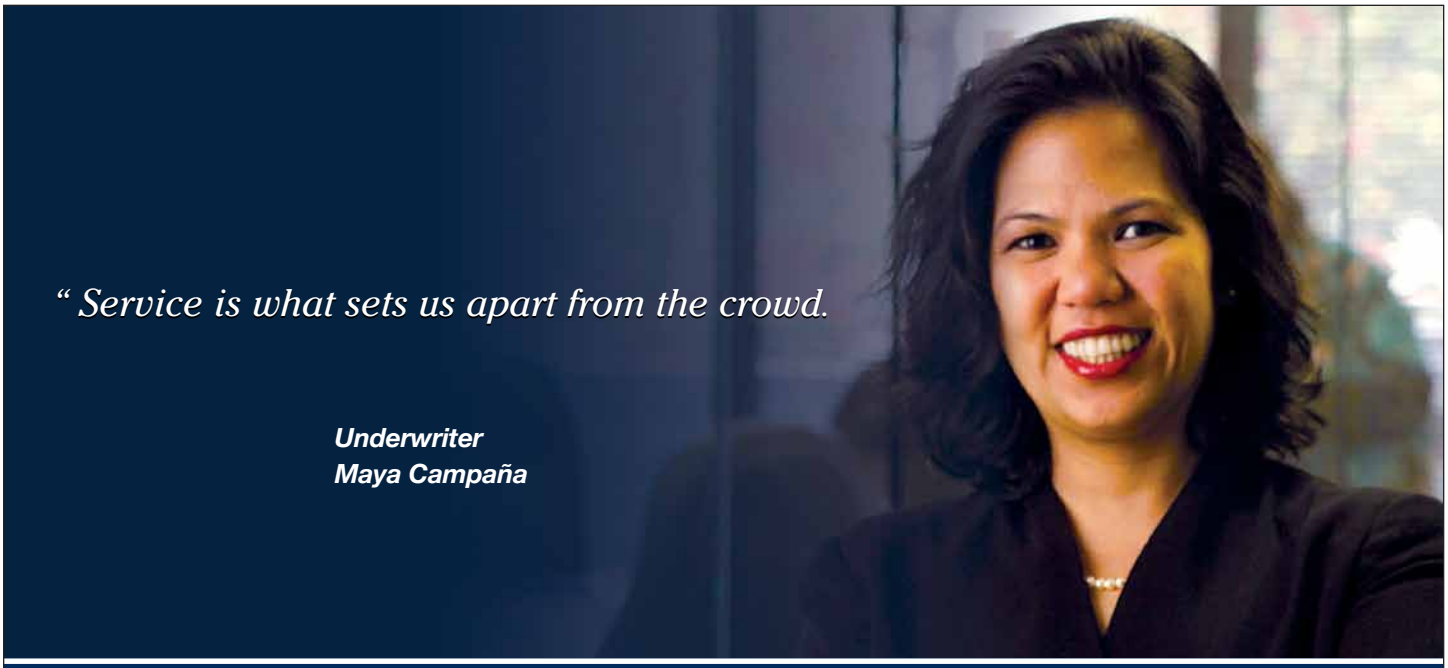

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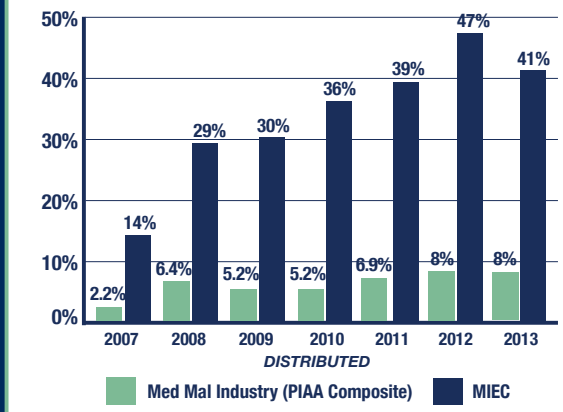

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