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EDITORIAL

Regarding Letters to the Editor

It has been the policy of the HJM&PH editorial board not to publish letters to the editor, for reasons centered about space constraints and recognition that the letters often embodied strident advocacy of a particular position without representation of any countervailing view.

As you might imagine, the onset of Obamacare, as well as multiple other contentious regulatory issues, and their associated trials and tribulations for the practicing medical professional, has engendered articulate correspondence — mainly negative in nature.

Such regulatory programs attempt a political solution to medical (and societal) problems. Those favoring one position or another are not likely to alter position and we do not believe the Journal can be a useful agent of change or education in areas of controversy where the best place to register such change is the ballot box.

Therefore, the HJM&PH will maintain the current policy of not publishing letters to the editor.
Inclusion Body Myositis: A Case of Bilateral Extremity Weakness

Luke Lam MD; Stephen Scheper DO; Natalia Zagorski MD; Mark Chung MD; Hiroji Noguchi MD, FACS; and Kore K. Liow MD, FACP, FAAN

Abstract
Inflammatory myopathy is a common cause of bilateral muscular weakness in adults. Although not as common as polymyositis, inclusion body myositis (IBM) is a form of inflammatory myopathy characterized by chronic progressive muscle inflammation and often goes undiagnosed and untreated. IBM patients most commonly present with proximal lower extremity weakness and may have normal creatine kinase (CK) levels. A high level of clinical suspicion is required for prompt and accurate diagnosis of IBM, which is diagnosed definitively with a muscle biopsy. The patient described in this case report is a 68-year-old man who initially presented with both bilateral symmetric proximal lower extremity and distal upper extremity weakness. IBM was suspected through history, electromyography, and definitively diagnosed with muscle biopsy. The patient was subsequently initiated on prednisone therapy and physical therapy, with improvement in muscular strength after 2 months. In patients presenting with bilateral extremity weakness and normal CK level, the diagnosis of IBM should be included in the differential diagnosis and muscle biopsy performed for appropriate cases.

Keywords
inclusion body myositis, inflammatory myopathy, weakness

Introduction
Inclusion body myositis (IBM) is an inflammatory myopathy characterized by chronic progressive muscle inflammation accompanied by muscle weakness. Although not as common as polymyositis, it is often missed and untreated. It has a prevalence ranging from 5 to 9 cases reported per million adults. It is the most common inflammatory myopathy in individuals over the age of 50 years. Unlike other inflammatory myopathies, IBM does not respond to treatment as well as polymyositis and has a slowly progressive clinical course, though uncommonly some patients do respond to steroid therapy. Because this is a relatively rare disorder, a high level of suspicion is required for the diagnosis of IBM, which requires a muscle biopsy. Prompt and accurate diagnosis of IBM is essential, both for initiation of management and for patient education regarding the clinical course of this disease. The case reported here is a patient with bilateral symmetric extremity weakness, with subsequent work up including a muscle biopsy revealing the diagnosis of inclusion body myositis. A literature review was conducted using the database search engine PubMed. Key inclusion criteria were peer-reviewed articles published in English with keywords including “inclusion body myositis,” “inflammatory myopathy,” and “weakness.”

Case Report
The patient is a 68-year-old man who was referred to a neurology clinic for further evaluation of a 2-year history of proximal and distal extremity weakness. In 2006, the patient was in his previous state of health until he accidentally dropped a chicken coop onto his right first metatarsal. He was eventually hospitalized and subsequently underwent a right transmetatarsal amputation. The patient over the next two years developed a peculiar painless pronounced inflammation of his phalanges on his hands and feet. It eroded the bone and eventually caused pathologic fractures of the 4th and 5th left fingers. Biopsies taken of the amputated toe in 2006 and the left 5th finger in 2011 showed a multinodular epithelioid granulomatous process with stains negative for fungus, bacteria, and acid-fast bacillus (AFB). According to his primary care physician, the inflammation resolved after a prolonged course of doxycycline.

In 2011, the patient was again taken to the emergency room following a non-traumatic fall. He was in his bathroom when his legs suddenly collapsed. He denied any loss of consciousness, acute pain, or discomfort. He was discharged from the emergency room with no further diagnostic testing. Since his fall in 2011, he noticed progressive bilateral symmetric weakness in his proximal and distal lower extremities. He reported having difficulties ambling — initially requiring a cane and subsequently a walker to assist with walking. He also noticed progressive bilateral symmetric weakness in his hands. He had difficulties performing daily tasks such as opening a jar and gripping handheld objects. He denied weakness in his upper extremities, shoulders, facial, and ocular muscles. He also denied myalgia, dysphagia, headache, lightheadedness, vertigo, loss of consciousness, vision and hearing impairment, or sensory loss. His past medical, family, and social history are noncontributory.

On physical and neurologic exam, patient’s vital signs were within normal limits. He appeared alert, awake, in no acute distress, and was pleasant and cooperative. His muscle strength was 5/5 bilaterally on arm abduction at the shoulder, elbow extension, and elbow flexion; 4/5 bilaterally on wrist flexion, wrist extension, and finger abduction; and 2/5 bilaterally on hip flexion, knee extension, and foot dorsiflexion. His gait was significant for difficulty standing from a sitting position without assistance, and short steps when walking forward. The rest of his neurologic exam, including cranial nerves, sensation, reflexes, and cerebellum exam, was within normal limits.

Laboratory testing including basic metabolic panel, liver function test, erythrocyte sedimentation rate, uric acid, anti-nuclear antibodies, rheumatoid factors, aldolase, and acetylcholine receptor antibodies were all within normal limits. His total creatine kinase was mildly elevated at 221ng/mL, with normal reference range being <200ng/mL for adult males.

Nerve conduction studies (NCS) were performed and revealed a mild sensory and motor axonal peripheral neuropathy predominant in the lower extremities. Monopolar needle electro-
myography (EMG) was more consistent with an inflammatory myopathic pattern, demonstrating diffuse denervation potentials with proximal predominance, including the lumbar/thoracic/cervical paraspinal nerves, but without significant fasciculations. Motor units were more neuropathic in nature with large amplitude, long duration, and polyphasic potentials. However, motor unit recruitment was overall normal to increased, and more consistent with a myopathic pattern. The combination of inflammatory myopathic needle EMG with peripheral axonal sensory polyneuropathy on NCS was indicative of IBM.

Biopsy of the left deltoid muscle was performed and pathology slides contained adequate material with extensive maceration type artifacts, which limited the evaluation. On review of pathology slides, small foci of endomysial infiltrates of chronic inflammatory cells were present. Atrophic myofibers were present as scattered single fibers. There was an increased number of myofibers with internally located nuclei. No significant fiber type grouping or predominance was identified. Target/targetoid fibers were not identified. Blood vessels were unremarkable. No significant fibrosis or necrosis was identified. The thioflavine S stain for amyloid in paraffin sections of skeletal muscle revealed the presence of rare fluorescent intra-sarcoplasmic amyloid inclusions (Figure 1). The Mendell modification of the Congo red stain revealed the presence of rare fluorescent inclusions associated with vacuolar structures within cryo-sections of skeletal muscle (Figure 2).

Treatment with prednisone 1mg/kg/day was initiated. The patient was also referred to physical therapy for strength training. In subsequent clinic follow ups, the patient reported improvement in muscular strength in both his lower and upper extremities. He tolerated his prednisone therapy well with no reported side effects. He was also in compliance with his physical therapy sessions and his daily exercises as recommended by his physical therapists. On neurologic exam, his muscular strengths improved, with 3/5 bilaterally on hip flexion, knee extension, and foot dorsiflexion. The rest of his physical and neurologic exam was unchanged.

Discussion

The etiology of IBM is unknown, and there is continuing debate as to whether IBM is primarily a T-cell mediated inflammatory myopathy or a myodegenerative disorder. Pathogenesis likely involves the invasion of CD8+ lymphocytes in endomysium, basophilic rimmed vacuoles within muscle fiber sarcoplasm, and cytoplasmic/intranuclear inclusions containing amyloid beta proteins. The interaction among these various pathological changes remains unknown. In this patient, it is likely that a form of chronic infection may be the triggering factor of IBM. Several viruses, including Coxsackieviruses, influenza, paramyxoviruses, cytomegalovirus, Epstein-Barr virus, and HIV have been indirectly associated with IBM. However, sensitive studies have failed to prove a definitive connection between IBM and these viruses.

IBM is characterized by chronic progressive muscle inflammation and should be suspected in all patients with unexplained progressive muscle weakness. Weakness is initially most common in the proximal lower extremities, which slowly progress to the distal and upper extremities. Though atypical, initial presentation of IBM patients with bilateral distal and upper extremity weakness has also been reported. Distal extremity weakness occurs in 50% of patients. In patients with distal extremity weakness, about 35% note distal extremity weakness being as severe as or more severe than proximal extremity weakness. Myalgia and dysphagia are also seen in approximately 40% of patients. In patients with bilateral symmetric weakness in upper or lower extremities, inflammatory myopathies and IBM are amongst the differential diagnoses. In this case, the patient presented initially with both proximal and distal extremity weak-
nernesses. The etiology of his weakness is likely multifactorial, since chronic disuse of his extremity as a consequence of his inflammatory condition in 2006 may have further contributed to his extremity weakness, making the diagnosis of IBM more elusive.

Diagnosis of IBM is typically made on the basis of muscle weakness, normal or mildly elevated muscle enzymes, myopathic features seen on electromyography, and characteristic findings on muscle biopsy. There is no diagnostic laboratory test for IBM, although a normal or mildly elevated serum creatine kinase may suggest a myopathic process. Serum creatine kinase is elevated in 89% of IBM patients. In IBM patients with elevated serum creatine kinase, it is usually elevated <10 times of normal reference limits, differentiating them from patients with more common myopathy like polymyositis. For adult males, this elevation is usually within the range of ~200–2,000ng/mL. In this case, the patient’s initial creatine kinase was measured at 221ng/mL.

While electromyography is not diagnostic of IBM, it is often helpful in suspected cases. EMG may also be helpful in identifying highest yield biopsy sites and assessing response to therapy. EMG findings in IBM include diffusely increased insertional activity, spontaneous fibrillations and positive sharp waves (denervation potentials), and complex repetitive discharges typical for all inflammatory myopathic diseases. Low-amplitude/short duration polyphasic motor unit potentials are typical; however, neuropathic findings such as large amplitude and long duration potentials can also be seen in IBM which often complicates the diagnosis. Approximately 35-50% of cases demonstrate findings of peripheral neuropathy on nerve conduction studies. Indeed, mixed findings with features of both myopathic and neurogenic disease are common in IBM.

Muscle biopsy is necessary for the definitive diagnosis of IBM especially in light of possible long-term treatment for patients. In light microscopy, the endomysial chronic inflammatory infiltrate is similar to polymyositis. Small group fibrous atrophy mimicking necrotic muscle atrophy and fiber hypertrophy is also common. The important diagnostic feature of IBM is the slit-like vacuoles in the sarcoplasm surrounded by hematoxyphilic granules called the rimmed vacuoles. Sometimes these vacuoles contain eosinophilic inclusions. Rimmed vacuoles have also been noted in rare myopathies such as X-linked myopathy with excessive autophagy and distal myopathy with rimmed vacuoles, but the chronic inflammatory infiltrate is lacking in both conditions. The inclusions of IBM are congophilic, and some of the material associated with them show immunoreactivity to beta-amyloid protein, ubiquitin, and phosphorylated tau. Congophilic amyloid inclusions can usually be seen in sections stained with Congo red or Thioflavin S. Ubiquitin staining is also useful in showing muscle fiber inclusions.

Differential diagnosis for IBM includes polymyositis, dermatomyositis, drug induced myopathies, adult onset muscular dystrophy, and denervating conditions such as amyotrophic lateral sclerosis. Differentiating IBM from the aforementioned diagnoses is important as management, and prognosis varies amongst the different conditions causing muscular weakness. The major pathological features of conditions within the differential diagnosis of IBM are summarized in Table 1.

### Table 1. Pathological features of muscle biopsy in conditions presenting with bilateral muscular weakness

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Pathological features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion Body Myositis</td>
<td>- Endomysial inflammatory infiltrates</td>
</tr>
<tr>
<td></td>
<td>- Rimmed vacuolated muscle fibers</td>
</tr>
<tr>
<td></td>
<td>- Intracellular amyloid inclusions</td>
</tr>
<tr>
<td>Neuropathy*</td>
<td>- Angular myofibers</td>
</tr>
<tr>
<td></td>
<td>- Fiber type grouping</td>
</tr>
<tr>
<td></td>
<td>- Target and tangeloid fibers</td>
</tr>
<tr>
<td>Polymyositis</td>
<td>- Endomysial inflammatory infiltrates</td>
</tr>
<tr>
<td></td>
<td>- Muscle fiber necrosis</td>
</tr>
<tr>
<td>Dermatomyositis</td>
<td>- Complement mediated microangiopathy</td>
</tr>
<tr>
<td></td>
<td>- Destruction of capillaries</td>
</tr>
<tr>
<td></td>
<td>- Perifascicular inflammatory infiltrates</td>
</tr>
<tr>
<td>Drug-induced myopathy</td>
<td>- Non-specific pathological findings</td>
</tr>
<tr>
<td>Adult onset muscular dystrophy</td>
<td>- Immunohistochemical staining detecting altered protein expression patterns (ie, immunoperoxidase stain for dystrophin)</td>
</tr>
<tr>
<td></td>
<td>- Molecular genetic studies detecting presence of mutations in specific genes</td>
</tr>
</tbody>
</table>

*Neuropathy includes motor neuron disease, spinal muscular atrophies, and acquired and hereditary motor and sensory neuropathies

The prognosis for IBM is relatively poor, with many patients requiring assistance with activities of daily living, and becoming wheelchair-bound and eventually bedridden in approximately 15 years. IBM is relatively resistant to standard glucocorticoid therapy. Prednisone treatment at dose level effective for other inflammatory myopathies is generally ineffective in IBM. However, in one retrospective review, prednisone appeared to have some modest clinical benefit in 40% of IBM patients. Immunosuppressive therapy with methotrexate and azathioprine similarly has shown only minor benefit. Given limited treatment options, consensus agrees that patients with IBM should be tried on prednisone 1mg/kg/day for 2-3 months, with consideration for addition of methotrexate 7.5mg/week or azathioprine 1.5-2.5mg/kg/day if the patient remains nonresponsive to therapy. This patient responded well to prednisone therapy at the recommended dose of 1mg/kg/day after 2 months of therapy. In addition, he reported great benefit from physical therapy. He will continue to have regular follow ups for assessment of his muscular strength and response to therapy.

**Conclusion**

In patients with bilateral symmetric distal extremity weakness, IBM should always be part of the differential diagnosis in addition to other myopathic conditions. It is important to make an accurate and definitive diagnosis early on with EMG and muscle biopsy, as IBM is a treatable condition. Goal of therapy should mainly be to prevent further deterioration of muscular strength, and glucocorticoid and immunosuppressive therapy are essential for management. Patients with IBM should be
informed of their prognosis, which is a progressive deteriorat-
ing course generally ending in immobility in 15 years, with
rare cases of muscular strength stabilization or improvement.

**Conflict of Interest**

None of the authors report a conflict of interest.

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HIV-Associated Neurocognitive Disorder (HAND) is a prevalent condition among persons with HIV resulting in cognitive impairments that may impact daily functioning. The relationship between neuropsychological (NP) test performance and functional status was investigated based on social services received (SSR) among 285 HIV-infected and 242 HIV-negative participants enrolled in the Hawai’i Aging with HIV Cohort. HIV-infected participants scored significantly lower than the HIV-negative group on all measures of NP testing and also reported receiving SSR at a higher rate. Among HIV-infected participants, more SSR correlated with poorer overall global NP performance ($p = -0.25, P < .001$), as well as poorer performance in NP domains assessing psychomotor speed ($p = -0.25, P < .001$), and learning and memory ($p = -0.19, P = .02$). NP test performance did not correlate with the number of SSR among HIV-negative participants. Supplemental Security Income (SSI) was the most commonly utilized social service among HIV-infected. Receiving SSI was associated with receiving more SSR at a higher rate. Among HIV-infected individuals, the unemployed showed twice the occurrence of impairment (22%) compared to the employed group (11%). As learning, memory, and executive functioning are often impaired in HIV, and employment status is affected by impairments in these areas, NP measures sensitive to these domains have been used as predictors for return to work and functional ability. Gorman and colleagues found that HIV-positive individuals who were unemployed were likely to have a higher prevalence of cognitive impairment that related to this review to physical impairment, CD4 count, and age. The purpose of the current study was to supplement current literature by investigating the relationship between NP test performance and the number of social services received (SSR) among HIV-infected individuals and to compare findings to individuals without HIV infection. It was hypothesized that lower NP testing scores would result in increased use of social services, suggesting a lower ability to live independently. This study further aimed to determine if specific NP measures were associated with the amount of social services received.

**Abstract**

HIV-Associated Neurocognitive Disorder (HAND) is a prevalent condition among persons with HIV resulting in cognitive impairments that may impact daily functioning. The relationship between neuropsychological (NP) test performance and functional status was investigated based on social services received (SSR) among 285 HIV-infected and 242 HIV-negative participants enrolled in the Hawai’i Aging with HIV Cohort. HIV-infected participants scored significantly lower than the HIV-negative group on all measures of NP testing and also reported receiving SSR at a higher rate. Among HIV-infected participants, more SSR correlated with poorer overall global NP performance ($p = -0.25, P < .001$), as well as poorer performance in NP domains assessing psychomotor speed ($p = -0.25, P < .001$), and learning and memory ($p = -0.19, P = .02$). NP test performance did not correlate with the number of SSR among HIV-negative participants. Supplemental Security Income (SSI) was the most commonly utilized social service among HIV-infected. Receiving SSI was associated with receiving more SSR at a higher rate. Among HIV-infected individuals, the unemployed showed twice the occurrence of impairment (22%) compared to the employed group (11%). As learning, memory, and executive functioning are often impaired in HIV, and employment status is affected by impairments in these areas, NP measures sensitive to these domains have been used as predictors for return to work and functional ability. Gorman and colleagues found that HIV-positive individuals who were unemployed were likely to have a higher prevalence of cognitive impairment that related to this review to physical impairment, CD4 count, and age.

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**Methods**

**Parent Cohort**

This was a cross-sectional analysis of baseline data from the Hawai’i Aging with HIV Cohort (HAHC) Study, a 5-year longitudinal study conducted between 2001 and 2006 to examine the impact of HIV and aging on various physiological, neurological, and neuropsychological dimensions. Briefly, the HAHC study recruited 157 older (age $>50$ years) and 128 younger (age $\leq 40$ years) HIV-infected participants with similar numbers of HIV-negative older and younger controls. All participants were living in Hawai’i at the time of enrollment, reported English as their primary language, and denied neurological or major psychiatric disorders, head injury, or learning disability. The parent study was approved through the University of Hawai’i Committee on Human Subjects and all participants provided informed consent which included permission to utilize data and specimens from the HAHC for future studies involving HIV and cognitive impairment.

**Procedures**

Data from HIV-infected and HIV-negative participants who completed data collection at entry (baseline) were utilized for this study. Data on younger and older participants were combined within the HIV-infected and HIV-negative group for the purpose of this analysis. Participants completed a comprehensive
Recall, Rey Complex Figure Test -Delayed Recall Trial; Executive function (NPZf); Trail Making Test - Part B, FAS. It is expected that higher NPZ composite scores are associated with higher functioning.

**Data Management and Statistical Analysis**

Spearman correlation coefficients were used to investigate the relationships between the number of SSR and NP test performance. Mann Whitney U was utilized to compare NP composite scores between groups. As SSI was the most commonly utilized social service in the HIV-infected population, univariate logistic regression was conducted to identify variables associated with availing of SSI. The effects of NPZ composite scores in availing of SSI were adjusted for significant socio-demographic variables ($P<.05$) using multivariate logistic regression. Analyses were completed using SPSS statistical software package, version 20.0, and Stata statistical software.

**Results**

As shown in Table 1, the cohort consisted of 285 participants infected with HIV (128 younger and 157 older) and 242 HIV-negative participants (120 younger and 122 older). HIV-infected and HIV negative groups were similar in ethnicity (57% Caucasian), gender (84% men), and in age and education distribution within their young and older respective groups. Within the younger HIV-infected group, the mean age and education was 35.1 (SD=4.8) and 13.2 (1.9) years, respectively. The older HIV-infected group had a mean age of 54.6 (SD=5.4) and education of 14.6 (SD=2.5) years. In the younger HIV-negative group mean age was 35.5 (SD=4.8) and education was 13.4 (SD=2.2) years. The older HIV-negative group had a mean age of 55.2 (SD=5.5) and 14.9 (SD=2.7) years of education (data not shown in table). Among the HIV-1 group, mean duration of HIV infection was 9.7 (SD=5.9) years, with a mean CD4 count of 459.3 (normal range: 500-1000 cells/mm3). Older participants differed from younger participants in duration of HIV infection (median 12.6 years vs 6.6 years), age (median 53.6 vs 36.5 years), and education (14 years vs 12 years). Table 1 shows baseline characteristics for the entire sample by group. HIV-infected participants received social services at a significantly higher rate ($P<.001$), with 70% receiving at least one service, compared to 28% in the HIV-negative group (data not shown in table). Although the HIV-infected group reported an average of two services (median 2.0, IQR=0.0,3.0) compared to an average of 0 (median 0, IQR=0.0, 1.0) services in the HIV-negative group, 20% of the HIV-infected group received four or more services compared to less than 1% of the HIV-negative group. The HIV-infected participants also scored significantly lower on all measures of NP testing (see Table 1). The number of SSR correlated with NPZglobal ($r=-0.3, P<.001$), NPZpm ($r=-0.3, P<.001$), and NPZlrnmem ($r=-0.2, P=.02$) (see Table 2). In contrast, the number of SSR was not correlated with NP test performance among the HIV-negative group.

Among the HIV-infected group, SSI was the most commonly utilized social service (40%). SSI is a Federal income supplement program funded by general tax revenues (not Social Security taxes). It is designed to help aged, blind and disabled people...
**Table 1. Baseline Characteristics of Subjects by Group**

<table>
<thead>
<tr>
<th></th>
<th>HIV+</th>
<th>HIV-</th>
<th>(P)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Size (n)</strong></td>
<td>285</td>
<td>242</td>
<td>-</td>
</tr>
<tr>
<td><strong>Gender (% male)</strong></td>
<td>239 (84%)</td>
<td>203 (84%)</td>
<td>.98</td>
</tr>
<tr>
<td><strong>Age (Mean, SD)</strong></td>
<td>45.83 (10.1)</td>
<td>45.43 (11.2)</td>
<td></td>
</tr>
<tr>
<td><strong>Education (Mean, SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity by group (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>163 (57.2%)</td>
<td>140 (57.9%)</td>
<td>-</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>80 (28.2%)</td>
<td>66 (27.2%)</td>
<td>-</td>
</tr>
<tr>
<td>Hispanic</td>
<td>19 (6.7%)</td>
<td>12 (5.0%)</td>
<td>-</td>
</tr>
<tr>
<td>African American</td>
<td>13 (5.6%)</td>
<td>12 (5.0%)</td>
<td>-</td>
</tr>
<tr>
<td>Native American/Alaskan</td>
<td>6 (2.1%)</td>
<td>6 (2.5%)</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>4 (7.1%)</td>
<td>6 (2.1%)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Duration of HIV infection (Mean, SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CD4 Count</strong></td>
<td>459.33 (245.17)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>CD4 Nadir Count</strong></td>
<td>224.31 (192.1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>NPZ Global +</strong></td>
<td>-0.10 (-0.52, 0.19)</td>
<td>.003 (-0.34, 0.34)</td>
<td>.002*</td>
</tr>
<tr>
<td><strong>NPZ Psychomotor Speed +</strong></td>
<td>-0.05 (-0.43, 0.30)</td>
<td>0.06 (-0.30, 0.36)</td>
<td>.045*</td>
</tr>
<tr>
<td><strong>NPZ Learning and memory +</strong></td>
<td>-0.24 (-0.82, 0.28)</td>
<td>-0.13 (-0.66, 0.50)</td>
<td>.01*</td>
</tr>
<tr>
<td><strong>NPZ Executive Functioning +</strong></td>
<td>-0.16 (-0.81, 0.36)</td>
<td>-0.04 (-0.56, 0.47)</td>
<td>.02*</td>
</tr>
<tr>
<td><strong>Median number of social services received per person</strong></td>
<td>2.0 (0.0, 3.0)</td>
<td>0.0 (0.0, 1.0)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td><strong>Total number of patients availing social security income (SSI)%</strong></td>
<td>112 (40%)</td>
<td>13 (5%)</td>
<td>&lt;.001*</td>
</tr>
</tbody>
</table>

**Note:** +Mann Whitney U and IQR reported; * significant difference between HIV+ and HIV-negative groups (\(P<.05\), two-tailed)

**Table 2. Correlations Between Number of Social Services Received and Neuropsychological Composite Scores by Group**

<table>
<thead>
<tr>
<th>Social Services Received</th>
<th>HIV-infected (n= 285) Spearman’s (\rho)</th>
<th>P-value</th>
<th>HIV-negative (n=242) Spearman’s (\rho)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPZ Global</td>
<td>-0.25</td>
<td>&lt;.001*</td>
<td>-0.08</td>
<td>.21</td>
</tr>
<tr>
<td>NPZpm</td>
<td>-0.25</td>
<td>&lt;.001*</td>
<td>-0.10</td>
<td>.14</td>
</tr>
<tr>
<td>NPZlrnmem</td>
<td>-0.19</td>
<td>.02*</td>
<td>-0.07</td>
<td>.30</td>
</tr>
<tr>
<td>NPZef</td>
<td>-0.12</td>
<td>.051</td>
<td>-0.08</td>
<td>.24</td>
</tr>
</tbody>
</table>

**Note:** * \(P<.05\), two-tailed.

who have little or no income, and provides cash to meet basic needs for food, clothing, and shelter. Because of its importance as a national program and its prominence in SSR among our HIV-infected participants, the role of NP performance as a risk factor for SSI was specifically examined. Analyzing the entire cohort, participants who were HIV positive were more likely to receive SSI than HIV-negative participants (adjusted odds ratio [aOR] 11.7, 95% confidence interval: [6.3, 21.0]), \(P<.001\), even when adjusting for living situation, work status, years of education, and age on multivariate logistic regression. HIV-infected participants availing SSI scored significantly lower than HIV-infected participants not availing SSI on all measures of cognitive functioning (NPZglobal: median -0.3 vs -0.01, \(P=.003\); NPZpm: median -0.2 vs 0.07; \(P<.001\); NPZlrnmem: median -0.4 vs -0.1; \(P=.04\); NPZef: median -0.4 vs -0.07; \(P=.04\)).

Subgroup analysis of participants by HIV status was conducted to investigate how NPZ scores impact the availing of SSI (Table 3). Among HIV-infected participants, lack of full time work, current CD4 count, CD4 Nadir, NPZglobal, NPZpm, NPZlrnmem, and NPZef were associated with availing SSI. In the multivariate analysis, NPZglobal (aOR=0.6, \(P=.04\)), NPZpm (aOR=0.5, \(P=.02\)), and NPZlrnmem (aOR=0.6, \(P=.02\)) as well as CD4 Nadir (aOR=1.0, \(P<.001\)) remained significantly associated with SSI. Lack of full time work was also consistently significant on multivariate logistic regression (aOR ranging from 14.2 to 19.2 depending on NPZ score used, \(P<.001\)).

Among the HIV-negative group, variables associated with availing SSI on univariate analyses were NPZglobal, and NPZpm. All HIV-negative participants without full time work (n=13) received SSI. Hence, work status was collinear on univariate logistic regression analysis.
### Table 3a. Factors Associated with Availing of Social Security Income Among HIV-infected Participants on Univariate and Multivariate Analyses

<table>
<thead>
<tr>
<th>HIV-infected</th>
<th>Univariate</th>
<th></th>
<th></th>
<th></th>
<th>Multivariate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>Confidence Interval (95%)</td>
<td>P-value</td>
<td>Adjusted Odds Ratio</td>
<td>Confidence Interval (95%)</td>
<td>P-value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.01</td>
<td>1.0, 1.03</td>
<td>.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.92</td>
<td>0.82, 1.01</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>1.31</td>
<td>0.69, 2.51</td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>1.25</td>
<td>0.77, 2.04</td>
<td>.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No full time work</td>
<td>15.89</td>
<td>6.16, 40.96</td>
<td>&lt; .001*</td>
<td>19.15</td>
<td>6.44, 56.97</td>
<td>&lt; .001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current CD4 count</td>
<td>0.99</td>
<td>0.99, 0.99</td>
<td>.04*</td>
<td>0.99</td>
<td>0.99, 1.0</td>
<td>.17</td>
<td></td>
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<tr>
<td>Nadir CD4 count</td>
<td>0.99</td>
<td>0.99, 0.99</td>
<td>&lt; .001*</td>
<td>0.99</td>
<td>0.99, 0.99</td>
<td>&lt; .001*</td>
<td></td>
<td></td>
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<tr>
<td>NPZglobal</td>
<td>0.38</td>
<td>0.23, 0.61</td>
<td>&lt; .001*</td>
<td>0.55</td>
<td>0.31, 0.99</td>
<td>.04*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPZpm</td>
<td>0.42</td>
<td>0.28, 0.64</td>
<td>&lt; .001*</td>
<td>0.54</td>
<td>0.33, 0.90</td>
<td>.02*</td>
<td></td>
<td></td>
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<tr>
<td>NPZef</td>
<td>0.73</td>
<td>0.56, 0.95</td>
<td>.02*</td>
<td>0.79</td>
<td>0.59, 1.07</td>
<td>.13</td>
<td></td>
<td></td>
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<tr>
<td>NPZlrnmem</td>
<td>0.56</td>
<td>0.40, 0.77</td>
<td>&lt; .001*</td>
<td>0.64</td>
<td>0.44, 0.94</td>
<td>.02*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3b. Factors Associated with Availing of Social Security Income Among HIV-negative Participants on Univariate and Multivariate Analysis.*

<table>
<thead>
<tr>
<th>HIV-negative</th>
<th>Univariate</th>
<th></th>
<th></th>
<th></th>
<th>Multivariate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>Confidence Interval (95%)</td>
<td>P-value</td>
<td>Adjusted Odds Ratio</td>
<td>Confidence Interval (95%)</td>
<td>P-value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.05</td>
<td></td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>.82</td>
<td>0.62, 1.09</td>
<td>.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.41</td>
<td>0.05, 3.28</td>
<td>.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>1.06</td>
<td>0.28, 4.0</td>
<td>.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPZglobal</td>
<td>.30</td>
<td>0.1, 0.88</td>
<td>.03*</td>
<td>.43</td>
<td>0.13, 1.36</td>
<td>.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPZpm</td>
<td>.33</td>
<td>0.14, 0.76</td>
<td>.01*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPZef</td>
<td>.66</td>
<td>0.33, 1.31</td>
<td>.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPZlrnmem</td>
<td>.50</td>
<td>0.23, 1.07</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Note: “No full time work” was collinear on univariate analysis.

### Discussion

The current study investigated the relationship between NP test performance and utilization of social services. HIV-infected participants endorsed receiving more social services of different types than their HIV-negative counterparts, and poorer NP test performance was associated with the need for social services. Furthermore, the current study found that poorer NP performance is a risk factor for being on SSI, a national social service commonly utilized by HIV-infected individuals, and that this association is independent of lack of work or of certain immunologic parameters.

The current study extends the information in this field by adding data that impairment in NP performance is linked to the use of social services. More specifically, the use of social services was extremely common among HIV-infected participants with 70% of participants receiving at least one service and 20% receiving four or more services. The need for such services among HIV-infected participants, as assessed by the number of SSR, correlated directly with global NP performance as well as sub-domain performance in psychomotor speed and learning and memory. Interestingly this association was not seen among HIV-negative participants, perhaps because the degree of impairment in this group may have been insufficient for such associations to be seen.

SSI, one costly aspect of SSR, was the most commonly utilized social service among HIV-infected participants, with 40% of participants utilizing this service compared to 5% in HIV-negative participants. SSI is also of particular significance because it is a national program with standardized criteria for eligibility. The current study demonstrated that impaired NP performance is a risk for need of SSI independent of lack of full-time work, or of current CD4 count, one important HIV-specific immunologic parameter denoting current immunologic status. No specific pattern of NP impairment was found in association with the need for social services. The need for social services was associated with global NP performance as well as with all NP subdomains assessed, with executive functioning perhaps demonstrating the weakest association. This is somewhat puzzling as many of the defined “social services received” in this study were associated with financial responsibility and external...
assistance, which is typically associated with impairments in executive functions (eg, organization and planning skills).\(^2\)

The study has several very important limitations. First, the study was a retrospective analysis of data collected between 2001 to 2006, and may not reflect the utilization of social services in more recent years. In addition, because the HAHC was recruited by young and old age groups with no individuals aged 40 to 49, the data may not accurately reflect the overall social service or NP performance status of the entire population of HIV-infected individuals.

**Conclusion**

In summary, the current study revealed that the use of social services was high in the HIV-infected population and NP impairment was associated with the need for such services. NP impairment was also found to be a predictor of being on SSI, independent of work status or HIV-specific immunologic parameters. The need for social services was not linked to any specific pattern of NP impairment. Interventions to address cognitive dysfunction among the HIV-infected population on potent ART may decrease the demand for social services.

**Conflict of Interest**

None of the authors identify a conflict of interest.

**Acknowledgements**

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**References**

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COURTESY OF HAWAI’I MEDICAL ASSOCIATION

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<table>
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<th>Location</th>
<th>Meeting Topic</th>
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<td>January 2014</td>
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<tr>
<td>February 2014</td>
<td></td>
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</tbody>
</table>
Single-incision Laparoscopic Cholecystectomy at Community Hospitals in Honolulu, Hawai‘i: A Case Series

Cori-Ann M. Hirai MD; Daniel Muraniu MD, MPH; Matthew D. Cooper MD; Andrew J. Oishi MD; Steven D. Nishida MD; Cedric S.F. Lorenzo MD; and Racquel S. Bueno MD, FACS

Abstract
This study aims to demonstrate the feasibility of implementing single-incision laparoscopic cholecystectomy in a community hospital setting. Minimally invasive surgical approaches for cholecystectomy achieve equivalent outcomes to the open surgical approach with less post-operative pain, improved cosmesis, shorter hospital stays, and decreased complications. Surgeons are attempting to reduce incisional trauma further by decreasing the number of incisions. A retrospective chart review was conducted for demographics, operating time, blood loss, conversion rate, length of stay, and presence of operative complications on patients undergoing single-incision laparoscopic cholecystectomy at two community hospitals between 2008 and 2011. One hundred and three patients (79 females and 24 males) underwent single-incision laparoscopic cholecystectomy. The mean age was 49.8 years (range 18-88). Ninety-six patients (93.2%) underwent elective procedures while 7 patients (6.8%) underwent urgent procedures. The mean operating time was 89.7 (± 28.3) minutes and the average blood loss was 33.7 (± 27.4) milliliters. Ninety-five (92.2%) of the procedures were successfully completed with a single-incision approach and 8 (7.8%) were converted to a multi-incisional approach, while none were converted to an open approach. The median length of stay was 4.75 hours. The post-operative complication rate was 7.4% (7/95) and included four superficial wound infections, one bile leak, one acute renal failure, and one urinary tract infection. These outcomes for single-incision laparoscopic cholecystectomy are comparable to other case series reported in the literature, and this retrospective review illustrates that single-incision laparoscopic cholecystectomy is feasible in a community setting.

Introduction
The advent of the first laparoscopic cholecystectomy in the late 1980’s led to a paradigm shift in surgical approaches. For the general surgeon, cholecystectomy was the ideal introductory procedure for minimally invasive surgery. The gallbladder’s fixed position to the liver in the right upper quadrant limited the scope of the operative field, minimizing camera maneuvering, and complex retraction requirements. Most importantly, the general surgeon’s familiarity with the open cholecystectomy and biliary anatomy allowed for rapid adoption of this procedure.¹

Mastery of the laparoscopic cholecystectomy built confidence in the surgical community and served as a platform for more complex laparoscopic intra-abdominal procedures. Minimally invasive surgical approaches are now commonly performed and have evolved to become the standard of care for many intra-abdominal procedures.¹ Laparoscopy has been shown to provide better cosmetic results, less postoperative pain, and shorter recovery time when compared to open approaches.¹ ² A laparoscopic approach to remove the gallbladder as an elective procedure has been the gold standard since 1992.¹

With the success of the laparoscopic cholecystectomy, surgeons continued to search for less invasive options for their patients. The next progressive step was reducing the number of incisions by consolidating the multiple incisions required to perform minimally invasive abdominal surgery to a single incision.¹ Reducing the number of incisions decreases the incisional trauma and results in less peri-operative pain. In the quest for less invasive surgery, surgeons and gastrointestinal endoscopists have recently pushed to move forward with investigating surgical approaches that require no abdominal incisions at all.³ Such approaches utilize natural orifices to access the abdominal cavity.

Unlike incision-less approaches utilizing natural orifices to perform intra-abdominal surgery, single incision laparoscopic surgery (SILS) maintains simplicity in the conduct of the operation. First, perforation of a visceral organ to access the abdominal cavity, a potential source of infection, is unnecessary. Additionally, the procedure remains largely unchanged and as a result no specialized instruments are required. The procedures can be performed with the use of standard laparoscopic instruments already available and familiar to surgeons performing laparoscopic surgery. Finally, for surgeons with a firm foundation in minimally invasive surgery, only minimal additional training is necessary, thus allowing for rapid adoption of the procedure.³

SILS has already been described for commonly performed minimally invasive procedures such as cholecystectomies, splenectomies, bariatric procedures, appendectomies, and colectomies.¹,4,5 Reducing the number of incisions required to perform laparoscopic surgery has its benefits. The approach improves cosmesis with comparable operative times to traditional multi-incisional laparoscopic surgery. It is also thought that peri-operative complications may also be reduced, resulting in decreased postoperative pain and overall lower rates of surgical site infection and herniation.¹,5,6 The added benefit of earlier return to normal activities and bowel function when compared to the multi-incision approach has also been noted.⁵ Finally, SILS utilizes equipment already available in current laparoscopic operative departments. The use of fewer trocars and instruments can potentially reduce hospital costs and the waste volume of disposable operating room devices.¹,4,7

SILS benefits both the patient and the hospital without compromising surgical techniques and requires minimal additional training for the surgeon. Single-incision laparoscopic surgeries at two major community-based hospitals performed by four general surgeons were reviewed. SILS was successfully performed at these institutions for cholecystectomy, appendectomy, and colectomy. This article reports the experience with single-incision laparoscopic cholecystectomy as this was the
most commonly performed procedure. The aim of this study was to demonstrate the feasibility of implementing single-incision laparoscopic cholecystectomy as an acceptable alternative to conventional laparoscopic procedure in a community setting.

Methods
From September 2008 through June 2011, 103 patients underwent single-incision laparoscopic cholecystectomy performed by four general surgeons at two major community hospitals affiliated with a university based surgical residency. After approval by each institutional review board a retrospective chart review was conducted for basic demographic information, indication for the operation, operative data, and postoperative care. Operative data included operating time (defined as time of incision to application of wound dressing), blood loss, conversion to open or traditional multi-incision approach, and presence of any intraoperative complications. Postoperative data included length of hospital stay (defined as time of wound dressing application to discharge) and presence of any peri-operative or postoperative complications such as wound infection, bile leak, intestinal perforation, or incisional hernia.

Operative technique varied slightly among the four surgeons based on experience, equipment availability at the two hospitals, and personal preference. All utilized an umbilical incision as the primary, single incision site. The procedure was considered single-incision even with the use of a Keith needle and stay sutures for better traction. This criterion is consistent with other studies in literature examining SILS procedures. Conversion to multi-incision was defined as the use of a second incision greater than 2 mm or large enough to insert another port.

Results
One hundred and three patients, 79 females and 24 males, were identified as having undergone single-incision laparoscopic cholecystectomies (Table 1). The mean age of our patient population was 49.8 years (range 18-88), and 96 patients (93.2%) underwent elective procedures with preoperative diagnoses consisting of chronic cholecystitis, symptomatic cholelithiasis, biliary dyskinesia, gallbladder polyps, or porcelain gallbladder. The remaining seven patients (6.8%) had more urgent preoperative diagnoses consisting of either acute cholecystitis (2.9%) or gallstone pancreatitis (3.9%) (Table 2). The mean operating time of completed single-incision laparoscopic cholecystectomy cases was 89.7 (± 28.3, range 45-165) minutes. The mean estimated blood loss was 33.7 (± 27.4, range 0-125) milliliters. Ninety-five (92.2%) of the cases were successfully completed as SILS and 8 (7.8%) were converted to a multi-incision approach (Table 3). There were no conversions to an open approach, and no intraoperative complications were noted. Same day discharge with mean length of hospital stay of 10.7 hours (± 10.3 hours, range 1-45) occurred in 87.4% (83/95) of patients. Median length of hospital stay was 4.75 hours. Reasons for observing the patient overnight included the need for adequate pain control and for the presence of significant medical co-morbidities, which occurred in 12 of the patients (12.6%). The postoperative complication rate of successfully completed single-incision laparoscopic cholecystectomies was 7.4% (7/95) and included superficial wound infection (4%), biliary leak (1%), acute renal failure (1%), and urinary tract infection (1%) (Figure 1).
Table 4. Complications, Operative Time, and Hospital Stay in Studies with N ≥ 40 (9-15) **NR – not reported

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Intraoperative complications, n (%)</th>
<th>Postoperative complications, n (%)</th>
<th>Mean operative time, minutes (range)</th>
<th>Mean hospital stay, hours (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brody, et al&lt;sup&gt;1&lt;/sup&gt;</td>
<td>59</td>
<td>1 (1.7%)</td>
<td>1 (1.7%)</td>
<td>92.6 (NR)</td>
<td>28.8 (NR)</td>
</tr>
<tr>
<td>Curcillo, et al&lt;sup&gt;6&lt;/sup&gt;</td>
<td>297</td>
<td>7 (2.4%)</td>
<td>20 (6.7%)</td>
<td>71 (NR)</td>
<td>36 (NR)</td>
</tr>
<tr>
<td>Dominguez, et al&lt;sup&gt;6&lt;/sup&gt;</td>
<td>40</td>
<td>2 (5%)</td>
<td>1 (2.5%)</td>
<td>93 (55-130)</td>
<td>NR</td>
</tr>
<tr>
<td>Erbella and Brunch&lt;sup&gt;11&lt;/sup&gt;</td>
<td>100</td>
<td>1 (1%)</td>
<td>0</td>
<td>30 (22-75)</td>
<td>24 (NR)</td>
</tr>
<tr>
<td>Hernandez, et al&lt;sup&gt;18&lt;/sup&gt;</td>
<td>100</td>
<td>1 (1%)</td>
<td>1 (1%)</td>
<td>72 (NR)</td>
<td>&lt;24 (24-240)</td>
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<tr>
<td>Rivas, et al&lt;sup&gt;9&lt;/sup&gt;</td>
<td>100</td>
<td>0</td>
<td>1 (1%)</td>
<td>50.8 (23-120)</td>
<td>NR</td>
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<tr>
<td>Roberts, et al&lt;sup&gt;16&lt;/sup&gt;</td>
<td>56</td>
<td>0</td>
<td>3 (5.4%)</td>
<td>80 (41-186)</td>
<td>7.2 (0-48)</td>
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<tr>
<td>Hirai, et al</td>
<td>103</td>
<td>0</td>
<td>7 (7%)</td>
<td>89.7 (45-165)</td>
<td>10.7 (1-45)</td>
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</table>

Table 5. Comparative Operative Time and Hospital Stay

<table>
<thead>
<tr>
<th>Study</th>
<th>Mean operative time</th>
<th>Mean hospital stay</th>
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</thead>
<tbody>
<tr>
<td>Hirai, et al</td>
<td>89.7 min</td>
<td>10.7 hours</td>
</tr>
<tr>
<td>Antoniou, et al (1)</td>
<td>70 min</td>
<td>33.6 hours</td>
</tr>
</tbody>
</table>

Patients in our study were followed up within one week. Further follow-up after one week was surgeon dependent, with most repeat visits at the discretion of the patient. Follow-up period lasted 1 to 33 months. There were no postoperative site hernias recorded within the follow-up period.

**Discussion**

SILS has potential advantages over the traditional multi-incision approach, such as improved cosmesis, shorter hospital stay, quicker return to daily activities, decreased cost to hospitals, and decreased volume of waste with fewer disposable trocar usage.<sup>1,4-6</sup> The push to develop less invasive procedures has led to the development of SILS and other procedures where no skin incisions are involved at all. Natural orifice transluminal endoscopic surgery (NOTES) accesses the intra-abdominal cavity through natural orifices such as the mouth, vagina, and rectum.<sup>7</sup> Entry into the abdominal cavity through these natural orifices, however, requires violation of the stomach wall, vaginal wall, or rectum in order to access the intra-abdominal structures. NOTES has sparked a considerable amount of investigation regarding its feasibility, efficacy, and safety, yet it remains in its infancy and has proved difficult to reproduce.<sup>8</sup> Although NOTES has failed to be widely embraced as an accepted surgical technique, it has encouraged the use of SILS and other less invasive surgical procedures.<sup>8</sup> The literature has reported a number of case series of SILS demonstrating improved cosmesis, comparable or reduced postoperative pain, and quicker return to function without compromising operating time or patient safety.<sup>1,4-6</sup>

The institutions participating in this study employ SILS as an acceptable option for patients with anticipated uncomplicated pathology and who desire a better cosmetic result. SILS is implemented utilizing standard laparoscopic equipment, and we have been able to demonstrate its feasibility at two community-based hospitals. The results of this study are comparable to other case series reported in the literature in terms of operative time, conversion rate, length of hospital stay, and complication rate (Table 4). A review article in 2011 by Antoniou, et al.<sup>1</sup> reports a mean adjusted cumulative operating time of 70 minutes with a range of 30-150 minutes. This study demonstrated a mean operative time of 89.7 minutes (Table 5). Although the learning curve of the participating surgeons was not specifically addressed or quantified, the literature suggests improved operating times with increased experience.<sup>1</sup> However, in the largest case series reported to date of 215 patients by Raakow and Jacob,<sup>10</sup> an improvement in operative time was not achieved. The authors speculated that the results suggest that as the surgeons gained experience, more difficult pathology was attempted via single-incision surgery. Though operating times may initially be longer for SILS, when compared to a traditional multi-incisional approach the potential benefits to the patient may eventually outweigh the burden of a longer operation. A preoperative diagnosis of acute cholecystitis and higher body mass index have been noted to increase operative time in other case series.<sup>1</sup> While two patients in this study had acute cholecystitis, body mass index was not specifically addressed. Prospective, randomized controlled studies would be necessary to study these risk factors.

Success of completing the single-incision approach in the review article by Antoniou, et al.<sup>1</sup> was found to be 90.7% with studies reporting a range of 53.6%-100% compared to this study’s 92.2% success rate. The reason for conversion in all cases was poor exposure of the biliary tree. Additional ports were needed for better traction on the gallbladder and to take down fibrous adhesions. Poor exposure of the biliary tree and excessive adhesions were unforeseen obstacles that could not be adequately assessed preoperatively, and thus the decision to convert was made intraoperatively. While this series did not have any intraoperative complications, they have been reported in other studies.<sup>1</sup> Most common intraoperative complications were uncontrolled bleeding requiring conversion to traditional laparoscopic or conversion to open approach. The most feared intraoperative complication remains injury to the common bile duct which would require further major surgery. Devascularization of part of the liver by clipping an aberrant hepatic artery.
has been described and may have substantial effects on patients, especially those with low liver reserves.\textsuperscript{11}

A number of the surgeons utilized “stab incisions,” which were made with a Keith needle to implement stay sutures for better traction on the gallbladder. Published reports do not consider this method to be multi-incision, as the puncture wounds did not require surgical closure or use of a dressing.\textsuperscript{1,5,8} These “stab incisions” were either left alone or a small amount of liquid skin adhesive was applied for adequate closure. Other published studies have demonstrated higher success rate and lower complication rate with patients of younger age, lower body mass index, use of sutures to suspend the gallbladder, and patients with uncomplicated pathology.\textsuperscript{1} Although not specifically addressed in this study, suspension sutures were used liberally amongst all surgeons and the majority of the patients had perceived uncomplicated gallbladder pathology.

The length of hospital stay was comparable to other case series with a median length of stay of 4.75 hours. The decision to admit the patient overnight for observation depended heavily on the time of day, age of the patient, need for adequate pain control, and the presence of other serious medical co-morbidities. This was deemed necessary by the attending surgeon for 12 patients (12.6%). The complication rate across all cases in the series was reported at 6.1%, with wound infection and hematoma (2.1%), bile leakage (0.4%), residual choledocholithiasis (0.3%) being the most common, and single cases of incisional hernia, intra-abdominal hematoma, and biliary stricture.\textsuperscript{1} These complications are similar to those experienced in traditional laparoscopic cholecystectomy.\textsuperscript{5,12,13} This study’s overall complication rate of 7.4\% is comparable to other SILS case series reported in the literature (Table 6). Though this rate is slightly higher than the overall complication rate reported in the literature for laparoscopic cholecystectomy, it can be hypothesized that the difference may be due to implementation of a new technique and the learning curve necessary to achieve proficiency.\textsuperscript{1,12} However, the rate of serious complications such as bile leak is similar to that of other series of SILS cholecystectomy and traditional multi-incision laparoscopic cholecystectomy.\textsuperscript{12,13} Superficial wound infections accounted for 4/7 of the postoperative complications. Local wound care was applied and further follow-up was not required in these patients. There was one case each of biliary leak and acute renal insufficiency. The patient with biliary leak was treated with an endoscopic retrograde cholangiopancreatography with sphincterotomy and stent insertion. At the patient’s six-week follow-up appointment, the patient still had residual pain and common bile duct stones were suspected. The patient presented six months later with a common bile duct stone that was removed by repeat endoscopic retrograde cholangiopancreatography and subsequently did well. The patient with acute renal insufficiency had underlying renal insufficiency with a baseline creatinine of 2.5. This worsened postoperatively and was managed by administration of intravenous fluids. The patient’s renal function returned to baseline at the postoperative follow-up office visit. This series did not have any cases of incisional hernias. Trocar-site hernias are a rare but known complication of laparoscopic surgery. Trocar size greater or equal to 10 mm is associated with an increased rate of hernia development; the incidence of trocar hernias ranges from 0.2\% to 3.1\% in large case series and reviews. Factors involved in the development of hernias include trocar size, location, trocar type, manipulation, entry and closure techniques, and preexisting fascial defects.\textsuperscript{14} There is a theoretical increase in incisional hernias with SILS when compared to the traditional multi-incision approach given that a larger fascial defect is created at the umbilicus. While no incisional hernias were reported, follow-up time was not standardized, and a prospective study would be necessary to assess it appropriately as a postoperative complication rate.

Implementing SILS raises the concern of financial cost to hospitals. It has been discussed in the literature that SILS theoretically may increase operating room times, require special equipment, and need extra training by surgeons, potentially increasing the cost of the procedure. A study by Love, et al,\textsuperscript{7} in 2011 found no significant difference in cost totals when all attempted single-incision laparoscopic cholecystectomies were compared with traditional multi-incision approach. They did find a significant difference in cost when single-incision laparoscopic

<table>
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<th>Table 6. Comparative Post-operative Complications</th>
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<td><strong>Hawai’i</strong></td>
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<td><strong>No. of Patients (ratio %)</strong></td>
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<tr>
<td>Wound complications</td>
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<td>Bile leak</td>
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<td>Acute renal failure</td>
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<td>Urinary tract infection</td>
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<td>Residual choledocolithiasis</td>
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<td>Biliary stricture</td>
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<td>Other</td>
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<tr>
<td>Total</td>
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Cholecystectomies were compared with converted cases and also when traditional multi-incision laparoscopic cholecystectomies were compared to the converted single-incision cases. This suggests no difference in cost to hospitals when implementing single-incision laparoscopic procedures. While conversion to a multi-incision approach may raise costs, with a relatively fast learning curve this too could potentially be eliminated with higher success rates. Single-incision laparoscopic procedures may even potentially lower the costs with the use of reusable trocars and a lower number of trocars required for surgery. The surgeons in this study used standard laparoscopic equipment and allotted the same amount of operating room time as a traditional multi-incision laparoscopic cholecystectomy. Exact cost, however, was not specifically examined in this study, and further prospective randomized controlled studies would be needed to evaluate the economic impact of SILS.

**Conclusion**

If the surgeon feels comfortable performing the surgery, we recommend that SILS be offered to patients with presumed uncomplicated gallbladder pathology who are eligible to undergo elective cholecystectomy. This study is one of the largest retrospective reviews performed in a community setting and we have shown comparable success rates, operative times, hospital length of stay, and complication rates to other reports of single-incision approach. The outcomes for single-incision laparoscopic cholecystectomy in this study are comparable to other case series reported in the literature, and complication rates are also comparable to multi-incision laparoscopic cholecystectomy. Single-incision laparoscopic cholecystectomy can be easily implemented without purchasing new equipment, allotting additional operating room time, or providing extensive training to surgeons already familiar with laparoscopic surgery. We believe that single-incision laparoscopic cholecystectomy is a viable option for community-based surgeons that can be implemented safely and without additional hospital resources, illustrating its feasibility in a community setting.

**Conflict of Interest**

None of the authors identify a conflict of interest.

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**References**


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432
A Survey of Musculoskeletal Injuries Associated with Zumba

Jill Inouye MD; Andrew Nichols MD; Gregory Maskarinec PhD; and Chien-Wen Tseng MD, PhD

Abstract
Zumba is a highly popular Latin-inspired dance fitness program with ~14 million participants in 150 countries. However, there is little published data on the rates or types of injuries among participants. We surveyed a convenience sample of 49 adults (100% participation) in 5 Zumba classes in Hawai‘i. Participants described any prior Zumba-related injuries. We used t-tests and logistic regression to determine if participant demographics or intensity of Zumba classes were associated with injuries. Participants were mostly female (82%), averaged 43.9 years of age (range 19 to 69 years), and took an average of 3 classes/week (1-2 hours/class) for an average of 11 months. Fourteen participants (29%) reported 21 prior Zumba-related injuries. Half of the 14 injured sought care from medical providers for their injuries. Of the 21 injuries, the most frequently injured sites were knees (42%), ankles (14%), and shoulders (14%). Participants with Zumba-related injuries did not differ significantly in age, months of Zumba, or hours/class compared to those who did not experience injuries. However, participants who reported injuries took significantly more classes/week (3.8 versus 2.7 classes, P = .006) than non-injured participants. In logistic regression, taking more classes/week remained significantly associated with injuries (odds ratio 3.6 [95% confidence interval 1.5 – 8.9, P = .006]) after controlling for age, gender, months of Zumba, and hours/class. Given Zumba’s health benefits, our finding that 1 in 4 Zumba participants have experienced injuries indicates the need to improve Zumba routines, instructor training, and health provider counseling to reduce injury risk.

Introduction
Zumba is an extremely wide-spread Latin-inspired dance exercise program that started in 2001 and has been gaining rapidly in popularity. Its motto is “Ditch the workout. Join the Party.” 1,2 An estimated 14 million people have participated in Zumba in over 150 countries. There are a wide variety of Zumba classes targeting specific participant groups, including children and elderly persons. 1,2 Zumba was predicted to be one of the top 10 fitness trends in 2012 by the American College of Sports Medicine (ACSM) based on a survey of more than 2,600 fitness professionals. 3 From a business point of view, Zumba is an important part of the multi-billion dollar fitness industry. There are Zumba DVDs, video exercise games, apparel, and accessories. 4 The goals of Zumba are for participants to improve strength, balance, coordination, and cardiovascular endurance. 1,2 Standard Zumba classes use high energy Latin and international beats, and usually last 1 to 2 hours. 2 As a popular form of exercise, Zumba can be a very important part of improving health and reducing obesity-related diseases, such as diabetes and hypertension. 5 Zumba also helps participants meet the ACSM recommendation of 150 minutes of cardiovascular exercise per week (30 minutes per day, five days per week). 6

Despite the popularity of Zumba, its relatively new development means there are few, if any, formal studies on the rates or types of injuries experienced by Zumba participants. Our literature search using PubMed found only one peer-reviewed study of Zumba, which focused on the benefits of Zumba in hemodialysis patients. 7,8 However, anecdotally, doctors are seeing more Zumba-related injuries. 7,8 The Accident Compensation Corporation, which insures all New Zealand residents and visitors, received more than 1,600 claims for Zumba-related injuries during a 2 year period. 9 Understanding the types of injuries that are common in Zumba can help the design of interventions to prevent unnecessary injuries. The Zumba fitness industry could better train Zumba instructors to develop routines that minimize the risk for injuries, and educate Zumba participants on how to avoid getting hurt. Since many individuals see their healthcare providers before starting exercise programs, providers could better counsel their patients on whether Zumba is an appropriate form of exercise for them, on how to avoid injuries, and promote awareness of common Zumba-related injuries. 9 Thus, the purpose of this study was to determine the frequency and type of injuries among Zumba participants.

Methods
This study was conducted with a convenience sample of 49 adults (age 18 and older) in 5 Zumba classes taught by different instructors at 5 different locations in Hawai‘i. Participants were randomly selected and asked to complete a short written survey on their age, gender, how long they had taken Zumba, number of classes per week, hours per class, if they had ever experienced any injuries from Zumba, and if yes, the body part that was injured, and if they sought medical attention for their injuries. Surveys were given before the Zumba classes and participants received no financial incentives. Simple descriptive analyses were used to describe the rate and type of injuries, and treatment sought. Bivariate T-tests and multivariate logistic regression were conducted using SAS 9.2 (SAS Institute, Cary, NC) to determine whether age, gender, duration of Zumba participation, number of classes per week, or length of Zumba classes were significantly associated with injuries. This study received IRB approval from the University of Hawai‘i Human Subjects Program. 10

Results
Demographics
Forty-nine participants completed the survey (100% response rate). Participants were on average 43.9 years old (standard deviation [SD] 12.1, range=19 to 69 years), and most were female (82%) (Table 1). Participants reported having taken Zumba classes for an average of 11.8 months (SD 6.7, range=3 to 30 months) and 3 classes per week (SD 1.3, range=1 to 5 classes per week). Classes taken by the participants ranged from 1 to 2 hours in duration.
Injuries
Fourteen of the 49 participants (29%) reported having experienced an injury while taking Zumba. Some participants reported multiple injuries, thus representing a total of 21 injuries. Of the 14 participants who experienced injuries, 50% sought medical attention, 14% self-treated (eg, applying ice, changing shoes, etc) and 36% did not seek treatment nor self-treat (Table 2). Of the 21 injuries, the most common anatomic site of injury was the knee (42%). The remainder of the injuries involved the ankle/foot (14%), shoulder (14%), elbow (5%), calf (5%), lower back (5%), neck (5%), thigh (5%), and muscle pain (5%).

Risk for Injury
Participants who had experienced Zumba-related injuries (Injured) versus those who did not experience injuries (Non-injured) did not differ significantly in age (44.9 versus 43.5 years, respectively; \( P = .74 \)), how long they had taken Zumba (13.1 versus 11.2 months, respectively; \( P = .35 \)), or the number of hours per class (1.21 versus 1.17 hours, respectively; \( P = .75 \)) (Table 3). However, in t-test analyses, injured versus non-injured participants took more classes per week (3.8 versus 2.7 classes, \( P = .006 \)). In logistic regression, the number of classes per week remained significantly associated with injury (odds ratio 3.6 [95% confidence interval 1.5 – 8.9, \( P = .006 \)]) even after controlling for age, gender, months of Zumba, and hours per class (Table 4). Reports of previous injuries were 56% amongst participants who said they took 4 or more classes per week versus 15% amongst participants who took 3 or fewer classes per week (Figure 1).

Discussion
Twenty-nine percent of our study participants reported injuries associated with Zumba. Of those who were injured, half sought formal medical attention. This is probably why healthcare providers have reported seeing more patients for injuries in Zumba despite few or no published studies on rates of Zumba injuries.\(^7,11,12\) Our results indicate that injuries do occur and are often serious enough for individuals to seek medical treatment. Given the popularity of Zumba and the importance of regular exercise to improve physical fitness,\(^4,13-16\) the Zumba fitness industry, public media, and healthcare providers need to look for ways to support Zumba while minimizing the risk for injuries among participants. Prospective studies are also needed to compare rates of injury in Zumba to other forms of dance fitness classes such as aerobics and jazzercise.

The anatomical sites of injuries in this study included the knee, ankle, thigh, shoulder, neck, and back, which are consistent with the range of Zumba-related injuries (ankle sprain, ankle fractures, torn meniscus, overuse injuries) seen by surgeons as reported by the American Academy of Orthopedic Surgeons.\(^11\) Consumer Reports’ Medical Advisor, Dr. Orly Avitzur, described treating patients for Zumba injuries ranging from ankle sprains to hip bursitis to knee problems requiring surgery.\(^11\) Zumba is based on dance moves, and our findings are similar to injuries observed among dancers (lower extremities, hip, and back

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<th>Table 1. Demographics of Study Participants (N= 49)</th>
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<tr>
<td>Age (years)</td>
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<td>Female*</td>
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<tr>
<td>How long took Zumba class (months)</td>
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<td>Classes per week</td>
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<td>Hours per class</td>
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*Five out of 49 participants did not give gender.

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<th>Table 2. Zumba-related Injuries</th>
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<tr>
<td>Participants reporting injuries (n= 14)</td>
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<tr>
<td>Sought medical treatment</td>
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<td>Self-treatment only</td>
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<td>No treatment needed</td>
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<th>Table 3. Factors Associated with Zumba-related Injuries</th>
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<tr>
<td>Injured</td>
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<td>Age (years)</td>
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<td>Months taken Zumba</td>
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<td>Hours per class</td>
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<th>Table 4. Zumba-related Injury - Adjusted Odds Ratio</th>
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<td>Adjusted Odds Ratio</td>
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<td>Age (years)</td>
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<td>Months taken Zumba</td>
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<td>Hours per class</td>
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Figure 1. Injuries by Number of Classes per Week
injuries) according to a systematic review in the *Journal of Dance Medicine and Science*.

Another article in the *Journal of Dance Medicine and Science* conducted a survey on professional modern dancers that showed 40% suffered injuries to the foot and ankle, 17% had injuries in the lower back, and 16% had injuries to the knee.

There has been speculation that new participants to Zumba are more susceptible to injuries because Zumba may be their first form of physical activity in a while. In this study, there were no significant differences between injured and non-injured participants in how long they had been taking Zumba. Most participants reported taking Zumba for almost a year. However, the study did not ask about the timing of injuries, and therefore did not determine whether injuries occurred when participants first started Zumba or after they had been taking Zumba for some time. Further studies would be helpful to determine if interventions to reduce Zumba-related injuries should target new participants in particular, or all Zumba participants regardless of experience level.

This study did detect an association between injuries and taking more classes per week, with more than half of those taking four or more classes per week reporting prior Zumba-related injuries. This has also been observed in research on classical ballet and jazz/contemporary dancers, where greater weekly frequency of practice was associated with occurrence of injuries.

Health providers could counsel participants to start with three or fewer classes per week, rest one or two days in between classes, and decrease the frequency of their workouts if they start to feel pain, discomfort, or fatigue.

Although Zumba is a relatively new form of exercise, dance and fitness programs such as aerobics and jazzercise have been around for longer and also involve many lateral (side-to-side) movements set to music. The types of injuries reported here are similar to what has been found for dance and aerobics (Achilles tendon pain, calf pain, shin splints, plantar fasciitis, etc.).

Thus, applying recommended injury-reduction techniques from dance, aerobics, and jazzercise to Zumba may be reasonable.

1) **Longer Warm-ups.** Warm-ups and cool-downs that include stretching, strengthening, and balance exercises have been found to be important for sports in general and in aerobics. Warm-ups allow the body to loosen and cause a gradual increase in heart rate. Cool-downs allow the heart rate to come down slowly and burn off lactic acid and adrenalin. Instructors may try to lengthen warm-ups to ensure participants are not going into the Zumba workout with cold muscles. Although controlled studies are needed to confirm their effectiveness, the ACSM still recommends “warm-up and cool-down” methods to reduce musculoskeletal injuries and complications. Thus, Zumba instructors should be aware of the importance of appropriate warm-ups and cool-downs when designing their Zumba routines.

2) **Wear proper shoes.** Both Zumba and aerobics include many side-to-side movements. In aerobics, some injuries are due to improper shoes and floor surfaces. Having the correct shoes may also decrease the risk for injury in Zumba. Participants may not be aware that the recommendation is to wear dance shoes or other shoes that provide stability for side-to-side motion and allow twisting and turning. Running shoes are not recommended because they have treads, which can cause the shoes to stick to the floor. The American Academy of Podiatric Sports Medicine (AAPSM) recommends having the right size toe box and a thick strap support for forefoot stability to prevent slippage of the foot. The official Zumba website (as well as other Zumba websites) could promote greater awareness of appropriate shoes for Zumba; instructors must be trained to include this information in handouts given to participants during class sign-up. Healthcare providers who recommend Zumba to patients, should also alert them to the need for proper shoes.

3) **Stay hydrated.** Healthcare providers should counsel their patients to stay hydrated to prevent nausea, dizziness, muscle fatigue, and cramping. The ACSM recommends drinking 8-12 ounces of water 10-15 minutes before exercise, and 3-8 ounces of water every 15-20 minutes during exercise (sports beverage if exercising greater than 60 minutes), and 20-24 ounces of water or sports beverage after exercise for every 1 pound lost. Furthermore, a healthy carbohydrate and protein snack every 2-3 hours can keep a steady source of energy and replenish depleted energy stores.

4) **Cross-training.** Cross-training, such as running, lifting weights, swimming, or cycling, can also help decrease the risk of injury.

5) **Smaller Zumba classes.** Being in overcrowded classes may place participants at higher risk for injuries because the instructor may not be able to see everyone and people may run into each other. One Zumba instructor recommended a class size of no more than 25 participants with 2 instructors so one instructor can teach while the other instructor walks around to see if anyone needs help.

6) **More training for Zumba instructors.** Zumba is a registered trademark and persons wishing to teach Zumba must be licensed by the Zumba Academy. Regardless of experience, all trainees take a 1 day class (10 hours) and are taught movements from 4 types of dance: merengue, salsa, cumbia, and reggaeton. Afterwards, Zumba instructors are allowed to create their own dance routines with their own music and moves. Thus, while there is some standardization due to licensing and training, there is also likely to be significant variation among actual Zumba routines and in instructor experience. Participants should ask their instructors how long they have been teaching Zumba and about their fitness backgrounds, such as dancing experience or fitness certification. More research is needed on whether specific dance movements are more likely to increase injuries, and whether Zumba training should teach potential instructors which dance moves to avoid.

7) **Picking an appropriate Zumba class.** Healthcare providers should also advise individuals to pick Zumba classes targeted to their specific age groups or other health demographics as appropriate. For instance, Zumba Gold modifies movements and pacing to suit the needs of older adult and Zumbatonic is specifically choreographed for children ages 4-12. Aqua Zumba is a water-based workout which is integrated with traditional aqua fitness.

8) **Treating with Rest, Ice, Compression, and Elevation of injured area (RICE).** Healthcare providers can counsel their patients on how to treat musculoskeletal injuries from Zumba with RICE as appropriate. When people are recovering from their injuries, they should be pain-free for more than 1 week, start back slowly, and not at the same intensity as prior to their injuries.
Limitations
Our study was a retrospective study of 49 participants and a larger, prospective study would help confirm our findings. We did have a 100% participation rate, and reported rates of injuries were relatively common (29%). However, our participants’ report of rates of injury, injury location, and medical treatment are subject to recall bias. Since we surveyed only current Zumba participants, injuries may have been underreported if persons with major injuries did not return to Zumba. We also did not inquire about participants’ fitness status prior to starting Zumba, their body mass index (height or weight), or any past injuries not related to Zumba, that could affect their risk for injury while participating in Zumba. We did not define “injury,” however participants who reported having experienced injuries provided details such as location and whether they sought formal care or self-treated.

Conclusion
Our study found that 1 in 4 Zumba participants reported previous Zumba-related injuries, with higher rates of injury among participants taking more classes per week (56% among those taking 4 or more classes per week). Given the benefits of regular physical activity, healthcare providers should continue to support patients’ participation in Zumba but actively counsel them on potential ways to minimize injury, such as choosing appropriate footwear, starting with 3 or fewer classes, finding an experienced instructor, and having proper hydration.

Conflict of Interest
None of the authors identifies a conflict of interest.

Acknowledgement
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References
Promoting Medical Student Research Using a Searchable Database of Research Projects at the John A. Burns School Of Medicine

Trevor Grace BS; Rachel Arakawa BA; Yawen Sarah Hsiao MSIS; Shannon Hirose-Wong PhD; and Reid Hoshide MD, MPH

Participation in research activities while in medical school is endorsed by medical students. Curricular programs aimed at supporting medical student research have been effective and well received. Research support is provided on a multitude of fronts, including central coordination by the office of medical education, faculty-student matching, financial support, and tailoring projects sensitive to student schedules. Students are able to build meaningful relationships with faculty mentors and develop systematic thinking, data analysis, and literature review skills. In addition, research is a means for students to contribute to their area of interest by demonstrating a zeal for scientific inquiry, thus enhancing their competitiveness for residency positions. For those willing to commit the time, participation in research is an invaluable medical school experience.

Medical students founded the Research Interest Group (RIG) at University of Hawai‘i John A. Burns School of Medicine (JABSOM) to improve medical student access to research opportunities. An informal survey, conducted in 2010, indicated high levels of research interest and participation amongst JABSOM medical students. Students also desired more research opportunities in clinical, community health, primary care, and community outreach. RIG continues to provide educational opportunities through a series of research seminars and strives to streamline the research process for all medical students.

The purpose of this study was to assess medical student support for an online, searchable database of research projects at JABSOM. In addition, information on student satisfaction with current resources for research opportunities was collected.

Methods

Approval for this study was obtained from the University of Hawai‘i Committee on Human Studies. In 2011, JABSOM medical students across all for four years were sampled using an anonymous online survey. The survey consisted of questions related to student’s demography, prior research experiences, and Likert-scale statements that explored their feelings toward current resources for finding research projects. Univariate analyses followed by ordinal regression models were utilized to discover the level of satisfaction with current JABSOM resources and to determine the support for an online, searchable database of research projects. Statistical analysis was done using SPSS (IBM SPSS Statistics).

Results

One hundred and nine JABSOM medical students responded to the survey (Table 1).

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<td>Current Participating in Research</td>
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<tr>
<td>Support for Database</td>
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MS1=First Year Medical Student; MS2=Second Year Medical Student; MS3=Third Year Medical Student; MS4=Fourth Year Medical Student. *Research experience before medical school

One hundred and four of the respondents (97%) agreed that an online searchable database of research projects would be beneficial when searching for a research mentor and project. Female students were more supportive of a research database than male students ($P = .021$). The first and second year students stated that they were more likely to use a database compared to the upperclassmen ($P = .001$, $P = .037$ respectively). Compared to students in their clinical years, first and second year medical students also believed that a research database would encourage students to conduct research projects ($P = .002$; $P = .025$, respectively). Furthermore, students without prior research experience were less satisfied with their search for research opportunities compared to students with a prior research experience ($P = .038$).

Discussion

With the implementation of JABSOM’s Problem Based Learning Curriculum in 1989, first year medical students were required to conduct a community-based research project during the summer between their first and second year of medical school. In
1999 and under Dean Edwin Cadman’s leadership, there was a dramatic increase in research grants and contracts awarded to JABSOM’s faculty members. As a result, the MD Program Committee (now called the Curriculum Committee) implemented a change in the student research requirement. Students were encouraged to work closely with a research mentor during their first year of medical school and to implement, analyze, and present their research in years 2, 3, and 4. In conjunction with this directive, Dr. Stephen Seifried developed an online research database to assist students with finding a research mentor. This database was discontinued in 2005 when JABSOM moved to its new campus in Kaka’ako.

The Class of 2008 was surveyed by Dr. Sheri Fong at the end of their fourth year about their research productivity while at JABSOM. There was a response rate of 88% (50 of 57 students), and 64% of the respondents (32 of 50 students) had either published or presented their work, submitted their work for publication or presentation, or had abstracts or manuscripts in progress. Students presented their research at local, national, and international conferences, and published in nationally recognized journals indexed by the National Library of Medicine.

The required research experience was discontinued in June of 2008 and replaced with a summer research elective in MD5 (summer electives) for the Class of 2011. This change in curriculum was implemented to allow students more flexibility in planning their summer courses, for example, opportunities for international travel. With the restructuring of the research curriculum, the Class of 2011 became the first cohort to complete the summer research elective. Dr. Fong hypothesized that the revised curriculum would still allow research-oriented students to develop valuable research opportunities. The Class of 2011 was surveyed in May of 2011 about their research productivity under the revised curriculum. There was a response rate of 80% (45 of 56 students). Preliminary data, presented at the annual meeting of the Association of American Medical Colleges (AAMC) Western Group on Educational Affairs in 2012, indicated that although the percentage of students who participated in research had dropped, the overall research productivity (as measured by the number and quality of papers published and number of presentations given) was greater than the Class of 2010, the last class who had the research requirement (data not shown).

Encouraging medical student research will help to address the need for more physician-scientists. Research principles are also clinically applicable, particularly translational medicine and clinical trial studies. In addition, students’ research achievements reflect highly on one’s home institution and community. Therefore, if JABSOM supports research during the preclinical years students will be more likely to pursue careers in academic medicine.

In this current study, 95% of the respondents were in favor of developing an online, searchable database of research opportunities. First and second year medical students, who expressed an interest in using the database and felt the database would encourage preclinical students to conduct research compared to students in their clinical years (data not shown). In addition, this study suggested that a research database would help improve access to research opportunities, especially for students without prior research experience.

It is concluded that an online, searchable database of research opportunities would be well received and utilized by JABSOM medical students. Future studies could assess the success of the database in satisfying student research goals as well as the database’s influence on the early participation in research activities.

Research-enrichment activities in the medical school curriculum are an important means of fostering medical student interest in research careers. Currently there is little evidence in the literature regarding the effectiveness of a centralized, searchable database of research opportunities for increasing medical student involvement in research. Therefore, the continued assessment and evaluation of the database’s usage by both students and faculty would be helpful in refining and modifying the research opportunities at JABSOM.

As a result of this study, Yawen Sarah Hsiao, Office of Medicine Education (OME), developed a searchable online database. It was placed online in December 2012. Researchers at JABSOM are now able to post online research opportunities for medical students. Each submission is first crosschecked with the faculty member’s Department and upon approval, the opportunity is added to the database. Database listings provide students with information about the project, contact information, application deadlines, location of project, and level of expected commitment. Students can then contact the principle investigator for more information. As of this date, thirty-seven entries representing 61 research projects are available to students (Table 2). The address for OME’s database is http://omejabsom.com/research/. Hopefully, JABSOM faculty members will continue to support

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<tr>
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<td>37</td>
<td>61</td>
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this database. Through the Research Interest Group, students are encouraged to periodically search the site for research opportunities (for more information about the database, contact Dr. Shannon Hirose-Wong in the Office of Medical Education).

**Study Limitations**
The cross-sectional design of this study means that the findings are associations rather than causations. These findings are not generalizable to other institutions. The finding that female students felt the database would encourage JABSOM students to conduct research more than male students may reflect a true gender difference but it could also reflect the small number of male respondents (n=3) who were not supportive of the database.

**Conflict of Interest**
None of the authors identify any conflict of interest.

**Acknowledgements**
The Office of Medical Education at the John A. Burns School of Medicine supported this project. Appreciation is extended to the survey-takers, the Research Interest Group members, and RIG’s faculty advisor, Dr. Kenton Kramer, for making this project possible and helping to improve access to research at JABSOM. The authors also gratefully acknowledge Drs. Sheri Fong and Damon Sakai for their critical review and comments.

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**References**
Abstract
The strengthening of health systems is fundamental to improving health outcomes, crisis preparedness, and our capacity to meet global challenges, such as accelerating progress towards the Millennium Development Goals, reducing maternal and child mortality, combating HIV, malaria and other diseases, limiting the effects of a new influenza pandemic, and responding appropriately to climate change. To meet these complex needs, the Association of Schools and Programs in Public Health, the World Health Organization, and the Institute of Medicine promote systems thinking as the only sensible means to respond to issues that greatly exceed the normal capacity of health and medical services. This paper agrees with the application of systems thinking but argues that health organizations have misunderstood and misapplied systems thinking to the extent that the term has become meaningless. This paper presents the basic constructs of systems thinking, explains why systems thinking has been misapplied, examines some misapplications of systems thinking in health, and suggests how the concept can be applied correctly to medicine and public health to achieve the reason it was adopted in the first place.

Introduction
Effective and capable health systems are a vital component in our approach to managing a wide array of health challenges. However, global threats and even local health service problems can appear overwhelming and without cure due to their inherent complexity. In response, many have encouraged the use of systems thinking as a means of deciphering complex situations and preparing adequately for complex events, such as crises and disasters, that have the potential for adverse outcomes. In health, a systems approach was promoted by the World Health Organization as a “fresh and practical approach to strengthening health systems,” and by the Institute of Medicine as a means to respond to an incident that greatly exceeds normal demands on health and medical capacity. Systems thinking has even become enshrined as an essential competency for all public health graduate students in the United States. The concept is fairly straightforward with the systems approach being defined as a “management strategy that recognizes that disparate components must be viewed as interrelated components of a single system.”

What makes systems thinking important? The famous philosopher, Edgar Singer, showed that all the known sciences and professions are engaged in the act of measuring the distance from one point to another. When the measurement becomes difficult, more observers are employed and they need to collaborate. As the process of measuring becomes more complex, more fields are involved, such as the social sciences, political science, psychology, mathematics, and others. Eventually, an overarching management plan is required to ensure that all endeavors are aligned to achieve the end goal. Applied to a public health issue, encouraging an obese population (Point A) to become a trim population (Point B), is a challenge that requires the involvement of many branches of knowledge that only a complex systems approach can adequately manage.

More often than not, our training teaches us to solve complex problems by breaking them up into discrete, manageable pieces and working to ensure each piece functions and performs as well as possible. However, much like the human body, it is not how well some parts are functioning that limits progress; it is how poorly other parts are doing. The success of some pieces does not equate to success of the whole and sometimes the alteration of one part can affect the performance of the whole. As our awareness of interactions and interdependencies grows, we increasingly recognize the limitations of reductionist approaches to understanding complex health problems that have many determinants. Understanding the whole system is more than being aware of the distinct components. It is about being aware of the relationships between the pieces and how they change when a single piece is altered.

Most management textbooks briefly describe systems thinking as a recent historical trend along with the commonsensical contingency viewpoint and total quality management framework, and rarely is any further mention made on the topic or on systems approaches. Inquiry systems are the basic constructs of systems thinking. They are never mentioned in these textbooks, but are essential to understanding how to implement systems thinking correctly.

Basic Constructs of Systems Thinking — How Do We Know What We Know?
Going back to basics, there are five different types of inquiry systems that we use to know something.

The first is based on agreement and is called the Consensual inquiry system. “The objectivity of science depends wholly upon the ability of different observers to agree about their data”. In this case, inputs are processed by experts who all agree on a single answer. The Delphi Method provides a good example of this construct. In an iterative process, the viewpoints of various
experts are obtained on a particular issue. Since consensus is the goal, the results are shared with participants in each round. Participants are influenced by the results to conform to the majority view and non-conformers (outlying views) are discarded as being invalid.

Analysis is the second inquiry system. In this case, the inputs are processed using an agreed upon formula and a single numerical answer results. The decision-making matrix provides a good example of this system. Mitroff and Linstone argued that “agreement” is an inductive-consensual inquiry system, “analysis” is a deductive inquiry system, and that both are only appropriate for simple, well-bounded, and well-structured problems or pieces of problems for which single numbers can serve as answers.11 The eminent Scottish philosopher David Hume clearly showed that the agreement and analysis constructs cannot be used to accurately establish causality.12 Hume argued that mere observations alone could never establish the logical necessity (causation) between two events because they have no insight into the inherent nature and intangible features of the events.

The third type of inquiry system is “multiple realities” which is based on the notion that the use of many models and observations will shed the best light on an issue because more angles will be covered.9 It moves from “analysis” to “meta-analysis” to produce explanations that individual analyses may not identify and is thus suitable for analyzing complex problems. The drawback of this system is that it assumes that each reality is unbiased.13 We can never collect information about a problem without first having some preconceived notion of what the problem is. Our initial sense, vague understanding, or intuitive conception of a problem is an internal model that is a source of bias called “Kant’s problem”. Furthermore, the multiple realities inquiry system is reductionist because it frames its results and presents problems in a technical context. Thus, the intangible issues like ethics, values, choice, culture, and aesthetics are omitted because they cannot easily be reduced to numbers that are truly representative.

In stark contrast to the Consensus model, the fourth approach to complex problems, the Dialectic inquiry system, uses contrasting views from experts that are furthest from the average.14 This is another form of the Delphi called the Policy-Delphi that is especially common in law, pros vs cons assessments, and the use of devil’s advocates. The assumption is that truth will emerge from the confrontation of opposites. Decisions are based on the stronger argument, which makes them dismissive of other points of view. This approach can be useful in dealing with complex problems because it can help to break down the faulty assumptions underlying the definition of a problem. However, it is simplistic given that intangible differences between presenters due to their inherent capacity and ability to convince others of their viewpoint can bias the entire process.

Mitroff and Linstone promoted a fifth type of inquiry system, which they called Unbounded Systems Thinking (UST) or the Multiple Perspectives inquiry model.11 It concerns the management of all modes of inquiry and it incorporates the other inquiry systems. The inputs are complex “messes” and may be viewed in a variety of ways, such as epistemic, ethical, aesthetic and spiritual. This approach is based on the idea that problems are the product of their interactions and not the sum of their parts. It is based on the belief that, because everything interacts with everything, the widest possible selection of branches of knowledge must be brought to bear on problems. The traditional hierarchy of the sciences and professions is abandoned in favor of equal weighting. This approach is recommended for complex, highly ill-structured, unbounded problems for which systemic views are essential even if they lead to confusion or stalemate (eg, global poverty or starvation).

The following outcomes show how to use these five systematic pragmatic inquiry systems by illustrating what happens when one moves from one model to another.

- Change from Consensus to Analysis or vice versa – because these are both based on a single truth, changes only serve to restructure, enhance or preserve the process and its outcomes

- Change from Consensus/Analysis to Multiple/Dialectic/UST – increases variety, models, and perspectives (vice versa: diminishes input and variety)

- Change from any model to Dialectic – increases conflict (vice versa: diminishes conflict)

- Change from UST to any other model – reduces number of systems considered, rendering the process vulnerable to errors in problem definition.

Thus, when initiating an investigation into a problem, it is most effective to begin with the UST inquiry model and only move downward to a less complicated model if the complexity of a situation warrants a downsizing. Attempting to upscale from a simple model, such as Consensus or Analysis, which is based on a single truth, to a more complex model, that incorporates many variant truths, is not recommended because belief in a single truth cannot be up-scaled. For example, ramping up an antiretroviral therapy program from one local population to a large regional population can be expected to have profound systemic effects, especially in less robust health systems.15,16 The different populations might each have their own version of the truth that did not conform to the regional model.

By using this process of managing systems thinking, we can gain insight into the reasons underlying incorrect problem formulations and bad decisions.

**Why Systems Thinking has been Misapplied**

Recognizing that a problem exists and taking action to solve a problem are two activities that many do well, but there is an in-between step that often receives inadequate attention. The source of all important management blunders can be traced back to a mistake in accurately discerning what is important in a situation and incorrectly formulating a problem to be addressed.17,19 Challenges to systems thinking come from individuals, institutions, and society which put overt and covert blockers
in the way of our ability to discern, assess, formulate, and solve problems. These blocking features can become complex and form their own system. For example, many company executives promote rationalizations that are a mix of truth, half-truth, distortions, and lies. They shamelessly promote TV violence, unhealthy food advertising, unethical behavior, tobacco, and alcohol when both anecdotal and evidence-based data clearly show their detrimental effects on individuals and society. They argue that freedom of expression is a higher cause or they use denial that a problem exists because it means that they do not have to participate in the solution.

Mitroff attributes this oversight to fundamental differences between critical and uncritical thinkers. While uncritical thinkers tend to focus on minimizing Type I and II errors, critical thinkers focus on Type III errors. Type I and II errors are taught in statistics classes and are associated with there being significant differences when we think there are none or vice versa. These errors relate to actions that are taken to solve a problem after it has been formulated. Type III errors occur during problem formulation and are caused by picking the wrong stakeholders, selecting a limited set of problem-solving options, incorrect phrasing, incorrectly defining the boundaries of a problem, and/or failing to think systematically by focusing on a part of a problem and ignoring connections.

The bewildering divorce between problem formulation and ethical behavior in company executives leads to inappropriate actions, which in turn lead to serious systemic breakdowns or malfunctions between technology, people, and organizations or societies. The Consensus and Analysis models are useful in investigating technological systems because they are typically simple in nature. Personal inventories and 360 evaluations are commonplace now as people seek a deeper understanding of themselves and how they relate to others. Understanding organizational and societal systems is more difficult and there is no agreement on what approach to use. Since these approaches are generally used without regard for extenuating circumstances in health, there are four different perspectives that each demonstrate certain limitations. The first three are used widely in health and other disciplines and the last is the only one that comes close to true systems thinking.

1) Using an approach called Industrial or System Dynamics, Jay Forrester, an engineer at the Massachusetts Institute of Technology, developed an approach to problem investigation in the 1950s. Forrester used mathematical computer simulations to provide insight into the flows and materials in subunits and the unintended consequences of problems. His work has been broadly applied to understanding flow-on problems in business, government, and research.

2) A more recent and subjective “technique” that attempted to claim the label “Systems Thinking” was developed in the 1980s by Peter Senge and has no clear definition or set of instructions. Systems Thinking, as defined by Senge, involves understanding how the pieces influence each other within a whole and it views problems as pieces of an overall system. However, rather than focusing on the problem pieces, which might have unintended consequences, it highlights cyclical relationships and nonlinear causes and effects in organizations. It has been useful in drawing attention away from problematic people and enabling people to concentrate on problematic systems. Efforts to create a framework for this approach use the term systems thinking loosely, revert back to mathematics and do not cater to intangible elements.

3) Niccolo Machiavelli observed how leaders related to their internal followers and how they dealt with external competitors and formulated a very different system to understand people and organizations. Although he recognized that some people were altruistic and moral, he found that most people were for the most part naturally and selfishly engaged in the ruthless pursuit of their own self-interest and that this activity was occasionally counter-intuitive and even irrational. Machiavelli also found that people naturally tended to exist within social or work groups in which they cooperatively exchanged resources or information. However, this cooperation was only seriously pursued when people believed that it would advance their own interests. If one accepts this interpretation of humanity, it is difficult to see how any methodology can accurately model systems that contain unknown personal interests and occasional irrational decision-making.

4) Unbounded Systems Thinking differs fundamentally in that it considers all inputs and accepts the messiness of all inputs. By doing so, it attempts to include, to whatever extent possible, knowledge of personal interests and counter-intuitive possibilities. Some of its core beliefs include recognition that:

- The designer of a system has a particular psychology that is important to know
- Strong consideration of ethics, values, judgments, and background experiences underline the choice of which perspectives are brought to bear on a problem
- The combined use of multiple technical, individual, and organizational perspectives to view any problem yield insights that each perspective could not reach alone
- Some subjective and intangible problem variables cannot be determined as “correct” and therefore cannot be assigned a weighting or value
- Perspectives may change over time as new information is revealed

Inappropriate Applications of Systems Thinking in Health

The need to understand complex systems with the aim of strengthening national and local health systems is well accepted and yet there have been few established frameworks or methodologies to implement. Less resourceful health systems lack the capacity to assess barriers to their success which provides little guidance to policy-makers. Even very simple health interventions can fail to achieve their goals due to the occasional unpredictable behavior of the system within which it operates. Every intervention affects its containing system, and every overarching system affects its interventions. For example, reducing the length of stay in one hospital ward may result in increased re-admission rates in another division which compromises overall quality and costs. Interactions at the systems level can be chaotic, with actions having unclear
relationships with outcomes. For example, interventions that aim to increase the quality of care usually succeed initially, but can decrease the quality of care over time as skills reach a peak and workloads become unacceptable. For these reasons, systems thinking has been promoted in health. But, as can be seen from the literature thus far reviewed, it remains somewhat abstract and the methodology is impractical, simplistic, or omits key parts of systems. To further complicate matters, ignorance of how humans acquire knowledge has resulted in the wrong inquiry models being used under the label of “systems thinking.”

Take, for instance, the Association of Schools and Programs in Public Health’s (ASPPH) inclusion of systems thinking as one of seven key interdisciplinary competencies for the nationally certified US Masters of Public Health degree. These competencies were developed using a 3-stage Delphi method. In the first round, there were 58 competencies relating to systems thinking, which were whittled down to 32 and 14 in subsequent rounds. In this case, a simplistic Consensus inquiry model was used to assess competencies for a very complex multidisciplinary program. Furthermore, many of the eleven systems thinking sub-competencies derived from Forrester’s System Dynamics limited method of understanding organizational subunits. This is very unlike public health, which usually draws from multiple perspectives, leaving one questioning the validity of the competencies. From a consultant’s viewpoint, the use of Systems Dynamics is favorable because its complicated implementation instills dependency that requires fee-for-service handholding. From a broader systems perspective, this approach to competencies began with the wrong inquiry model and uses a limited methodology. From a public health perspective, it is impossible to achieve many of the competencies beyond a superficial level because they are overly ambitious. For example, see #10. Analyze global trends and interdependencies on public health systems. Even attempts to apply the Delphi method to health disparities research resulted in simplistic models that presented only part of the whole picture.

A broader approach to systems thinking has been developed and applied by the Alliance for Health Policy and Systems Research in the World Health Organization. They view systems thinking as a powerful approach for guiding investments in health systems and they believe that failing to take health system complexity into account hinders efforts to achieve equitable outcomes. They are interested in moving away from vague and limited approaches to providing health workers with a clear method to strengthen health systems efficiently and equitably. They outline a process that includes four steps during the intervention design phase and six steps during the evaluation design phase. The evaluation steps are project management and not systems thinking, but the intervention steps demonstrate careful consideration of systems thinking. They are: convene stakeholders, collectively brainstorm, conceptualize effects, and adapt and redesign, which are all necessary components of problem formulation.

**Is There a Future for Systems Thinking with Health Leaders?**

Given that all evaluations are necessary simplifications of real-world complexity, systems thinking helps to determine how much and where to simplify. If one accepts that the priority is to minimize Type III errors in problem formulation, the reason for the systems thinking changes from the UST model of, “We need to understand everything about everything” to a more focused model of, “We need to know what is important.” This different perspective is far more focused, requires far less effort and is thus more achievable even in under-resourced health organizations. What is required for its success is a list of key activities (closely tied to the strongest reasons for Type III errors) and leaders who are capable of discerning what is important. This latter point is important because the ability to discern what is important was the highest ranked quality of excellent leaders in business, health, and emergency management professions across three countries.

Addressing the complex problems in healthcare systems is never going to be easy, but some knowledge on how to proceed is better than none. Leaders have to lead, managers have to manage, and we all need to make decisions throughout our lives. It is better that we do so without being ignorant of the psychological constructs and constraints within which we choose to operate. The careful selection of inquiry models is fundamental to systems thinking, which, when used appropriately, can assist us in correctly identifying the underlying problems that prevent progress. Above all, we need to move away from the simple consensus and analytical inquiry systems favored by economists because they fail to recognize that social dynamics are fraught with counter-intuitive behavior, that events may have multiple effects on different time scales, and that effects may gain sufficient momentum to become independent from causes and in turn become causes of further events.

Funding for global health concerns and health systems has steadily increased over the past decade, but this is entirely due to private increases in the Global Fund because government contributions have decreased by a third in the plans for 2012-2014. Private funders are more discerning and need to know what works in what context. They understand that even simple health interventions are highly complex so knowledge of the full range of systemic effects is imperative to mitigating detrimental behavior and amplifying possible synergies. Mere knowledge of a health system is insufficient and an appropriate inquiry method and systems perspective are required. Leaders need to be able to discern what is important so that they can employ the correct inquiry system and formulate problems correctly. Only with this approach can they be certain that they have taken every reasonable precaution before implementing a program or change or new course of action.
References

Bias in Self-reported Anthropometry in Relation to Adiposity and Adulthood Weight Gain among Postmenopausal Caucasian and Japanese American Women

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The Cancer Center Connection is a standing column from the University of Hawai‘i Cancer Center and is edited by Carl-Wilhelm Vogel MD, PhD; HJMPH Contributing Editor. Dr. Vogel is professor and former director of the University of Hawai‘i Cancer Center and has been the editor of this column since 2001.

Abstract
Adiposity is often approximated by body mass index (BMI) in population studies based on self-reported weight and height (kg/m²). However, self-reports tend to underestimate weight and overestimate height, leading to an underestimation of BMI and the prevalence of overweight and obesity. We examined a subgroup of the Multiethnic Cohort Study participants to determine how well self-reported and measured anthropometry correlate with each other, overall and by race/ethnicity, total and abdominal adiposity level, and amount of adulthood weight gain. A cross-sectional sample of 30 Caucasian and 30 Japanese American female cohort participants, between ages 60-65, was selected in such a way that the two groups had a similar BMI distribution across the range (18.5-40 kg/m²). Subjects first reported their weight, height, and waist and hip circumferences at home and within several days underwent objective measurements by trained staff and also a whole-body scan of dual energy X-ray absorptiometry (DXA) at a study clinic. The women under-reported their weight by 0.93 kg, waist circumference by 3.95 cm and hip circumference by 0.10 cm and over-reported their height by 0.85 cm. This led to an under-estimation of BMI by 0.67 kg/m² and waist/hip ratio by 0.04. The effect of misreporting (self-report minus measurement) on BMI and waist/hip ratio was significantly greater in higher BMI groups (p-heterogeneity = 0.007 for BMI, 0.0005 for waist/hip ratio), among women with central obesity (waist circumference > 88 cm; p-heterogeneity = 0.006, 0.01) and among women who had gained higher amounts of weight since age 21 (p-heterogeneity = 0.03, 0.01) compared to their counterparts. A similar trend of greater self-report bias was found among women with higher levels of DXA-based total and abdominal adiposity. We did not observe any heterogeneity in these findings by ethnicity. Our results confirm that a small degree of under-reporting exists in self-reported BMI and waist/hip ratio values, and it tends to increase in women with a larger current body size or history of greater weight gain. Studies are underway to investigate this question in greater depth in men and women from five race/ethnic groups.

Keywords
anthropometry, central obesity, obesity, race/ethnicity, self-report

Introduction
Excess body fat is a leading cause of cancer and overall chronic diseases.¹² In large epidemiologic studies of obesity, body mass index (BMI; weight [kg]/height [meter]²) based on self-reported weight and height is the most commonly used measure of overall body fatness. However, studies have observed that self-reporting tends to underestimate weight and overestimate height.¹ Also, the degree of under-reporting weight may be greater at high compared to low levels of BMI, whereas over-reporting height may be greater at older ages.¹³ We examined a subgroup of women in the Multiethnic Cohort Study to determine how well self-reported and measured anthropometry information correlates with each other, overall and by race/ethnicity, current total and abdominal adiposity, and adulthood weight gain.

Subjects and Methods
Study Participants
The current analysis is based on a cross-sectional study conducted in a small subgroup of the Multiethnic Cohort (MEC) Study. This ongoing prospective study, conducted in Hawai‘i and Los Angeles, consists of over 215,000 men and women aged 45-75 years at recruitment (1993-1996) and of mainly five race/ethnic groups.³ The design of the cross-sectional study was described in detail previously.⁴ Postmenopausal female MEC participants who were 60-65 years of age as of September 2009 and of either Caucasian or Japanese ethnicity were eligible. Women were excluded if they reported any of the following: current or recent smoking; use of certain medications (chemotherapy, insulin, or weight-loss drugs); substantial weight change in recent months; reported BMI outside the target range (18.5-35 kg/m²); and any soft or metal implants/objects in the body. Of the 218 women contacted, some were ineligible (21%), not reachable (10%), or unwilling to participate (35%). Among the 74 willing and eligible women (34%), we randomly selected 60 women (30 Caucasian, 30 Japanese American [JA]). In order to ensure that Caucasian and JA women would have a similar BMI distribution, equal numbers of women were recruited from the following BMI categories (computed from the weight and height reported on recruitment phone calls) within each ethnic group: 18.5-21.9, 22-24.9, 25-26.9, 27-29.9, and 30-35 kg/m².⁶ Participants underwent anthropometric measurements and a whole-body dual energy X-ray absorptiometry (DXA) scan at the University of Hawai‘i Clinical Research Center (CRC). The Institutional Review Board of UH approved the study protocol, and all participants signed an informed consent.
Self-Reported and Measured Weight, Height, and Circumferences

Participants received a questionnaire and a tape measure in the mail and were asked to write in their current weight and height, as well as self-measured waist and hip circumferences using the tape measure, within several days prior to their visit to the CRC clinic. During the clinic visit, trained technicians measured standing height, weight, and waist and hip circumferences. Standing height and weight were measured using a digital stadiometer (Measurement Concepts) and scale (Seca), respectively, with the participant wearing a gown or comparably light clothing. For both self-reports and objective measurements, waist circumference was taken at the navel, and hip circumference was measured at the widest area between the waist and thighs, including the buttocks. Each measurement was taken twice, and a third time if the two measures differed by >0.1 kg or by >0.5 cm, after which the average of the two closest values was used in the analysis.

DXA Measurements of Total and Regional Body Fat

A whole-body DXA scan (GE Lunar Prodigy, Madison, WI) was performed to measure total and regional body fat mass in the trunk, arms and legs, as well as lean soft tissue mass and bone mineral content. The trunk-to-periphery fat mass ratio (TPFR) was calculated as an indicator of abdominal fat distribution by dividing the fat mass in the trunk by the sum of fat mass in the arms and legs.

Statistical Analysis

All analyses were performed using the SAS Statistical Software, version 9.3 (SAS Institute, Inc., Cary, NC), based on the nominal level of $\alpha=0.05$ for statistical significance. Two outliers were excluded from the analysis because the self-reported height (177.8 cm) or hip circumference (116.8 cm) was greater than 3 SDs above the measured value (152 cm and 92.1 cm, respectively), leaving a sample size of 58 for analysis. The differences (self-reported value—objective measurement) in weight, height, BMI, waist and hip circumferences, and waist/hip ratio were normally distributed. Mean differences were examined in all study participants and with stratification by ethnicity and level of BMI, central obesity (defined by waist circumference >88 cm) and weight gain since age 21 (tertiles). Similarly, we examined the mean differences by DXA-based direct measurement of total adiposity (tertiles of percent total fat over total body mass) and abdominal adiposity (below- vs above-median TPFR). All women had reported their weight at age 21 on the MEC baseline questionnaire (1993-1996). Heterogeneity in mis-reporting, ie, variation in the differences between self-reports and measurements, across the ethnicity, current adiposity and weight-gain strata was assessed using the analysis of variance $F$ statistic in a general linear model. Adjusting for age did not influence the results. Graphic illustration is also presented for BMI differences between reported and measured values vs measured BMI, separately for the body size and weight gain categories, and with linear regression lines overlayed. Pearson correlation coefficients were obtained between self-reported and measured anthropometric values, overall and across the above strata.

Results

We previously reported the descriptive characteristics of the cross-sectional study participants and a significant race/ethnic difference in abdominal, visceral and liver fat distribution. By study design, the participants had a similar BMI distribution and range (18.5-35 kg/m² based on self-reports; 18.5-40 kg/m² based on measurements) in both ethnic groups (Table 1). Overall, the women under-reported their weight by 0.93 kg (2.05 lbs) and over-reported their height by 0.85 cm (0.33 inches), which led to an under-estimation of BMI by 0.67 kg/m² (range -5.97, 3.27). They also under-reported waist (by 3.95 cm or 1.56 inches) and hip (by 0.10 cm or 0.04 inches) circumferences, yielding a slightly under-estimated waist/hip ratio (by 0.04; range -0.16, 0.10). There was no significant variation in misreport between the two ethnic groups for any of the anthropometric indicators. The under-estimations of self-reported weight and waist circumference were significantly greater for the higher BMI group, among women with central obesity (waist circumference >88 cm), and among women who gained higher amounts of weight since age 21. These biased self-reports resulted in increasing under-estimations of BMI and waist/hip ratio among heavier women ($p$-heterogeneity=0.007 and 0.0005, respectively, for BMI and waist/hip ratio), women with central obesity ($p$-heterogeneity=0.006,0.01), and women who experienced more adulthood weight gain ($p$-heterogeneity=0.03,0.01) (Table 1). This is also illustrated in Figure 1 for BMI. Greater self-report bias was similarly observed at higher levels of DXA-based total adiposity (percent total fat; $p$-heterogeneity=0.008 and 0.006 for BMI and waist/hip ratio, respectively) and abdominal adiposity (TPFR; $p$-heterogeneity=0.09 and 0.03) (Table 1).

The correlation between self-reported and measured values was high for weight and height ($r>0.75$) and for resultant BMI ($r \geq 0.90$), except for BMI among overweight ($r=0.58$) and obese women ($r=0.73$) (Table 2). Correlations were more moderate for waist and hip circumferences ($r>0.70$) and waist/hip ratio ($r \geq 0.62-0.81$).

Discussion

Our findings confirm that self-reports lead to an under-estimation of body weight and BMI in women. Also, we observed a similar trend in waist circumference reports and subsequent waist/hip ratio estimates. The overall magnitude of under-estimation in this study population was relatively small at 0.67 kg/m² for BMI and 0.04 for waist/hip ratio. Also, the correlation between self-reported and measured values was high, indicating that investigations of reported anthropometry in relation to cancer or other health outcomes may be minimally affected in ranked, categorical analyses. However, the magnitude of self-report bias was greater among overweight and obese women, women with greater abdominal adiposity, and women who had gained more than 5 lbs compared to their recalled weight at age 21. Such differential extent of bias would attenuate the risk estimates.
Table 1. Self-reported and Objectively Measured Anthropometry

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>Weight, kg</th>
<th>Height, cm</th>
<th>BMI, kg/m²</th>
<th>Waist Circumference, cm</th>
<th>Hip Circumference, cm</th>
<th>Waist/Hip Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-report</td>
<td>65.6 (45.4-90.7)</td>
<td>156.6 (142.2-168.9)</td>
<td>26.1 (18.6-34.9)</td>
<td>90.9 (66.0-137.2)</td>
<td>102.0 (81.3-134.6)</td>
<td>0.89 (0.72-1.02)</td>
</tr>
<tr>
<td>Measurement</td>
<td>66.5 (44.9-100.8)</td>
<td>157.7 (143.1-166.8)</td>
<td>26.8 (18.8-39.6)</td>
<td>94.8 (70.3-134.9)</td>
<td>102.1 (84.7-130.8)</td>
<td>0.93 (0.78-1.10)</td>
</tr>
<tr>
<td>DIFFERENCES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All participants, n=58</td>
<td>-0.93 (2.78)</td>
<td>0.85 (2.31)</td>
<td>-0.67 (1.28)</td>
<td>-3.95 (5.50)</td>
<td>-0.10 (3.06)</td>
<td>-0.04 (0.05)</td>
</tr>
</tbody>
</table>

By Race/Ethnicity

Caucasians, n=30
-1.10 (3.04) 1.23 (1.79) -0.83 (1.28) -3.92 (5.76) -0.30 (2.88) -0.03 (0.05)

Japanese Am, n=28
-0.75 (2.51) 0.45 (2.75) -0.49 (1.28) -3.98 (5.32) 0.11 (3.27) -0.04 (0.05)

p-heterogeneity 0.63 0.20 0.31 0.96 0.61 0.58

By BMI, Measured

18.5-24.9kg/m², n=23
-0.12 (2.17) 0.62 (2.06) -0.22 (0.85) -1.62 (3.93) -0.20 (3.11) -0.02 (0.04)

25-29.9kg/m², n=21
-0.91 (1.16) 0.66 (2.88) -0.58 (1.08) -3.72 (5.00) -0.67 (2.68) -0.03 (0.05)

≥ 30kg/m², n=14
-2.30 (4.54) 1.52 (1.70) -1.54 (1.72) -8.12 (6.30) 0.91 (3.46) -0.08 (0.05)

p-heterogeneity 0.07 0.47 0.007 0.001 0.33 0.0005

By DXA % Total Fat

Fat < 38.5%, n=19
0.31 (1.28) 0.49 (3.14) 0 (0.97) -1.41 (4.28) -0.22 (3.10) -0.01 (0.04)

Fat 38.5-44.4%, n=19
-1.34 (1.97) 0.58 (1.69) -0.73 (0.86) -3.19 (3.90) -0.16 (2.93) -0.03 (0.04)

Fat ≥ 44.5%, n=20
-1.73 (3.94) 1.45 (1.86) -1.25 (1.59) -7.08 (6.45) 0.06 (3.28) -0.06 (0.06)

p-heterogeneity 0.05 0.36 0.008 0.003 0.96 0.006

By Central Obesity, Measured

Waist ≤ 88 cm, n=22
0.18 (1.65) 0.59 (1.95) -0.09 (0.70) -1.70 (4.04) -0.37 (3.22) -0.02 (0.04)

Waist > 88 cm, n=36
-1.61 (3.11) 1.01 (2.52) -1.02 (1.43) -5.32 (5.86) 0.06 (2.99) -0.05 (0.05)

p-heterogeneity 0.02 0.51 0.006 0.01 0.61 0.01

By DXA Trunk-to-Periphery Fat Ratio (TPFR)

TPFR < 1.2, n=30
-0.30 (1.57) 0.93 (1.81) -0.39 (0.72) -3.02 (5.61) -0.75 (3.05) -0.02 (0.05)

TPFR ≥ 1.2, n=28
-1.61 (3.57) 0.76 (2.79) -0.96 (1.65) -4.94 (5.31) 0.59 (2.96) -0.05 (0.05)

p-heterogeneity 0.07 0.78 0.09 0.19 0.09 0.03

By Weight Gain Since Age 21

Gain <5 kg, n=12
1.10 (2.13) 1.70 (2.29) -0.09 (0.49) -1.39 (4.04) -0.71 (3.73) -0.01 (0.04)

Gain 5-14.9 kg, n=22
-0.73 (2.03) 0.42 (1.53) -0.44 (0.91) -3.03 (6.04) -0.13 (2.48) -0.03 (0.06)

Gain ≥ 15 kg, n=24
-2.14 (3.08) 0.83 (2.84) -1.16 (1.65) -6.06 (5.00) 0.23 (3.25) -0.06 (0.04)

p-heterogeneity 0.003 0.31 0.03 0.03 0.69 0.01

Mean differences (SD) across ethnicity and levels of current BMI, DXA-based percent total body fat (tertiles), central obesity, DXA-based trunk-to-periphery fat ratio (TPFR; below vs above median), and adulthood weight gain were compared in analysis of variance, and the significance of heterogeneity was determined using F statistic in general linear models.
Table 2. Correlation Between Self-reported and Objectively Measured Anthropometry

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Height</th>
<th>BMI</th>
<th>Waist Circumference</th>
<th>Hip Circumference</th>
<th>Waist/Hip Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>All, N=58</td>
<td>0.98</td>
<td>0.92</td>
<td>0.97</td>
<td>0.93</td>
<td>0.96</td>
<td>0.76</td>
</tr>
<tr>
<td>By Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasians, n=30</td>
<td>0.98</td>
<td>0.93</td>
<td>0.98</td>
<td>0.93</td>
<td>0.97</td>
<td>0.70</td>
</tr>
<tr>
<td>Japanese Am, n=28</td>
<td>0.99</td>
<td>0.79</td>
<td>0.97</td>
<td>0.92</td>
<td>0.94</td>
<td>0.75</td>
</tr>
<tr>
<td>By BMI, Measured</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal-weight, n=23</td>
<td>0.94</td>
<td>0.93</td>
<td>0.91</td>
<td>0.81</td>
<td>0.78</td>
<td>0.74</td>
</tr>
<tr>
<td>Overweight, n=21</td>
<td>0.98</td>
<td>0.91</td>
<td>0.58</td>
<td>0.74</td>
<td>0.88</td>
<td>0.67</td>
</tr>
<tr>
<td>Obese, n=14</td>
<td>0.81</td>
<td>0.92</td>
<td>0.73</td>
<td>0.86</td>
<td>0.92</td>
<td>0.81</td>
</tr>
<tr>
<td>By Abdominal Obesity, Measured</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist ≤ 88 cm, n=22</td>
<td>0.96</td>
<td>0.95</td>
<td>0.95</td>
<td>0.76</td>
<td>0.79</td>
<td>0.74</td>
</tr>
<tr>
<td>Waist &gt; 88 cm, n=36</td>
<td>0.95</td>
<td>0.89</td>
<td>0.93</td>
<td>0.87</td>
<td>0.96</td>
<td>0.62</td>
</tr>
<tr>
<td>By Weight Gain Since Age 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain &lt;5 kg, n=12</td>
<td>0.99</td>
<td>0.91</td>
<td>0.99</td>
<td>0.95</td>
<td>0.91</td>
<td>0.81</td>
</tr>
<tr>
<td>Gain 5-14.9 kg, n=22</td>
<td>0.96</td>
<td>0.96</td>
<td>0.95</td>
<td>0.73</td>
<td>0.93</td>
<td>0.72</td>
</tr>
<tr>
<td>Gain ≥ 15 kg, n=24</td>
<td>0.95</td>
<td>0.83</td>
<td>0.90</td>
<td>0.91</td>
<td>0.95</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Pearson correlation coefficients were obtained between self-reported and objectively measured anthropometry. The P-values for all the correlations, except the ones noted in parentheses, were <0.01.

of the true association between excess adiposity and disease outcomes, and highlight the need to account for, in analysis, the factors that may modify the degree of self-report bias.

The comprehensive anthropometry data collected in this study allowed us to examine self-report bias in waist size, as well as BMI estimation, and to compare the misreporting by the level of DXA-based direct measurements of total and abdominal adiposity. Our study participants, as in previous studies that compared self-reported and measured anthropometry, might have reported their weight, height, and circumferences more accurately than they would have if they had not agreed to a follow-up clinic visit. We did not observe any significant difference in misreport within the narrow study age range (60-65 years) or between the two ethnic groups that had balanced BMI distributions by study design. Therefore, our study may not be suitable to test the heterogeneity in self-report bias by age or ethnicity.

We are currently expanding the cross-sectional investigation to 2,000 men and women of all five ethnic groups in the MEC, including Native Hawaiians, African Americans, and Latinos, and will be able to examine in greater depth whether bias in self-report varies among the sex-ethnic groups, as well as with increasing levels of adiposity and adulthood weight gain. This study may also enable us to identify some other factors that are associated with reporting error, including eating behaviors, fitness and etc.

Conflict of Interest
The authors declared no conflict of interest.

Acknowledgements
Funding for this study was provided in part by the National Cancer Institute for the Multiethnic Cohort (R37 CA54281: LNK), for University of Hawai‘i Cancer Center seed funding (P30 CA071789: Carl Vogel) and for the "Obesity, Body Fat Distribution and Cancer Risk in the Multiethnic Cohort" study (P01 CA168530: LLM), and by the National Center for Research Resources at NIH for the University of Hawai‘i Clinical Research Center (P20 RR11091: Jerris Hedges). We thank the study participants and the dedicated staff at the University of Hawai‘i Cancer Center (Karim Koga, Eugene Okiyama, Naomi Hee, Janice Nako-Piburn, Janine Abe, Wileen Mau, Maj Earle) and Clinical Research Center (Sara Murakami, Jane Yakuma, Patty Iwamoto).

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- Department of Human Nutrition, Food and Animal Sciences, University of Hawai‘i, Honolulu, HI (RN)
Figure 1. BMI underestimation from self-report across BMI range stratified by current body size and adulthood weight gain.

Linear regression of the difference in BMI (self-report minus measurement) on measured BMI across (1a) three BMI levels (18.5-24.9, 25-29.9, ≥ 30kg/m²), (1b) central obesity (waist ≤ 88cm, waist > 88cm), and (1c) weight gain since age 21 (< 5kg, 5-14.9kg, ≥ 15kg), noted in green, purple and red for increasing levels of strata, where applicable.

References
THE ULTIMATE HOME BREW.
This fascinating case was reported in the July issue of International Journal of Clinical Medicine. A 61-year-old man in Texas was found to be drunk on a continuing basis, but he denied drinking. For five years, he often staggered and had great difficulty in daily functions. His wife, a nurse, measured his blood alcohol content (BAC) and found it to range into upper 0.20’s while at home and not drinking. When he appeared in the hospital emergency room with a BAC of 0.37, four times the limit for driving, the staff refused to believe he had not been drinking. After 24-hour hospital observation with tight controls, he was still intoxicated, and the medical staff investigated further. His gut was turning food into booze. The underlying problem is thought to be an overgrowth of yeast in the stomach whereby his gut ferments carbohydrates into alcohol. It’s called auto-brewery syndrome, a relatively unknown phenomenon in most medical circles. After a regimen of anti-fungal medication, his BAC dropped to zero. The world is not always what it appears to be.

THE DOCTOR CAN’T SEE YOU NOW. HE CHECKED OUT.
What good is health insurance if no one takes it? As if the Obama health plan didn’t have sufficient headaches already, Centers for Medicare and Medicaid Services (CMS) found 9,539 physicians who previously accepted Medicare, opted out in 2012. In 2009 the number was 3,700. The journal Health Affairs found that 33% of primary care physicians did not accept new Medicaid patients in 2010-2011. The American Academy of Family Physicians survey reported that 4% of family physicians are now in cash-only or concierge practices where patients pay a monthly or yearly fee for special access to doctors. Economist Paul Ginsburg, president of the nonprofit Center for Studying Health System Change, said, “Medicare has really been pushing its luck with physicians.” Jeffrey Cain, President of the American Academy of Family Physicians, said “Family physicians have been fed up for a long time, and it’s getting worse.”

A STANDOUT CASE IN CRIMINAL LAW!
An unusual but grisly swimming pool accident brought a criminal complaint of manslaughter against Shoreline Pools of Stamford, Connecticut. A 6-year-old boy drowned in a pool without a mandatory safety drainage device the company failed to install. Congress passed a federal law in 2007 to prevent entrapment in public pools and spas. The Virginia Graeme Baker Act was named for the granddaughter of former Secretary of State James Baker when suction trapped her at the bottom of a spa. Shoreline Pools President David Lionetti pleaded guilty to misdemeanor criminally negligent homicide. Civil suits are widespread over personal injuries from pharmaceuticals to heavy equipment, but criminality is considered rare. “For heaven’s sake, it’s a criminal case,” said Steve Dunn, a pool safety consultant. As part of a separate plea, Shoreline Pools was ordered to pay $150,000 to a pool safety organization.

I’LL TAKE ‘THE JUNGLE,’ ALEX, FOR $100.
At a Detroit auto show in August Nissan predicted an affordable driverless auto will be marketed by year 2020. Toyota and Audi AG showed off self-driving technology at the Consumers Electronic Show in Las Vegas. Japanese car makers are under special pressure to make the world safe from elderly motorists. Head-on collisions in Japan are epidemic due to oldsters cruising on the wrong side of divided highways. It sounds ideal to have a robot driving while passengers are texting or watching U-tube on the iPad. Hold on there, commuters. There are many pot-holes on this electronic road. What about liability, who pays for a crash? Will the injured party sue the company designing the algorithm, or the car’s owner, or a passenger for failing to take control? Knowing they are programmed to avoid collision, other drivers will inevitably learn to exploit them by cutting in or racing ahead for a parking place, or perhaps teenagers might want to play chicken. Moreover, privacy will disappear when every action in cyberspace can be monitored, recorded and policed. The technology seems unstoppable, but the real struggle is balancing individual freedom and public safety. The struggle is between us and us. Do you want to be in the jungle or the zoo?

WE MUST PROTECT OUR YOUNG PEOPLE FROM THEMSELVES.
The US Food and Drug Administration (FDA) is considering restrictions on menthol cigarettes. In 2009, the FDA announced that it was banning all flavored cigarettes, citing their attraction for children. Menthol was an exception. A big deal was applauded by many in the public health arena. Not really so big, because only 0.2% of the US cigarette market was banned while menthol flavored products accounted for 25%. Toxicity is about the same as unflavored cigarettes, but authors of the latest report said that menthol use is likely associated with increased smoking initiation by young people. Moreover, the authors claim menthol smokers show greater signs of nicotine dependence. P. Lorillard, Inc, whose Newport menthol cigarettes account for 90% of its sales, isn’t backing away from a fight. The company is threatening court action over anything other than modest restrictions. Is someone forcing these kids to light up?

SOMETHINGS NOT ROTTEN IN NORWAY.
For centuries, Norwegians and other Europeans have reused graves after 20 years. In Norway they get free cemetery plots, but only for two decades. After that, somebody has to pay rent to keep the plot and headstone. If not, the ground becomes available to bury someone else. After World War II Norwegians began a three-decade-long practice of wrapping bodies in plastic, believing the practice to be more sanitary. An unexpected result is that bodies do not deteriorate in plastic. The prevailing law is that if a grave is opened from the period when they used plastic, it cannot be reused, even if no one is paying rent. Expanding cemeteries is an expensive and unpopular solution. Science comes to the rescue. A former graveyard worker, recalling his chemistry class, devised a simple solution. By poking a hole in the ground through the plastic and injecting a lime-based solution the body will decompose within a year. He created a business called Nomias, and has performed the process on 17,000 graves. The city of Oslo pays the company 4,000 kroner ($670) per grave.

GOOD GRIEF! DOES THIS MAKE THE INFAMOUS TWINKIE DEFENSE LEGITIMATE?
Researchers at the University of California San Diego School of Medicine studied nearly 1,000 men and women relating irritability and aggression to diet. By using a wide range of measures in men and women of all ages and race, they studied dietary trans fatty acids (DTFAs). The survey measured factors of life history of aggression, conflict tactics, self-rated impatience and irritability and recent aggressive behavior. Results showed that DTFAs were significantly associated with greater aggression and “were more consistently predictive of aggression and irritability across the measures tested.” Would these data explain the recent confrontation and ultimate shooting death in a Honolulu McDonald’s?

ADDENDA
- We share 98.4% of our DNA with a chimpanzee, 70% with a slug.
- We share 98.4% of our DNA with a chimpanzee, 70% with a slug.
- We share 98.4% of our DNA with a chimpanzee, 70% with a slug.
- We share 98.4% of our DNA with a chimpanzee, 70% with a slug.

ALOHA AND KEEP THE FAITH RTs
(Editorial comment is strictly that of the writer.)
BIGIN LOANS
AT SMALL LOAN RATES

For a limited time, you can get a Jumbo Loan at an affordable 15- or 30-year conforming loan rate.

<table>
<thead>
<tr>
<th>Current Term (as of 11/6/13)</th>
<th>Interest Rate</th>
<th>APR (as of 11/6/13)</th>
<th>Monthly Principal and Interest Payment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-year fixed</td>
<td>4.125%</td>
<td>4.153%</td>
<td>$3,150 for 360 months</td>
</tr>
<tr>
<td>15-year fixed</td>
<td>3.125%</td>
<td>3.175%</td>
<td>$4,528 for 180 months</td>
</tr>
</tbody>
</table>

*Payments do not include property taxes or insurance which may increase monthly payments. Example based on a $650,000 loan amount and 25% down payment for a purchase transaction. Rates subject to change without prior notice.

- 0.50% discount on closing cost fees for any purchase transaction¹
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