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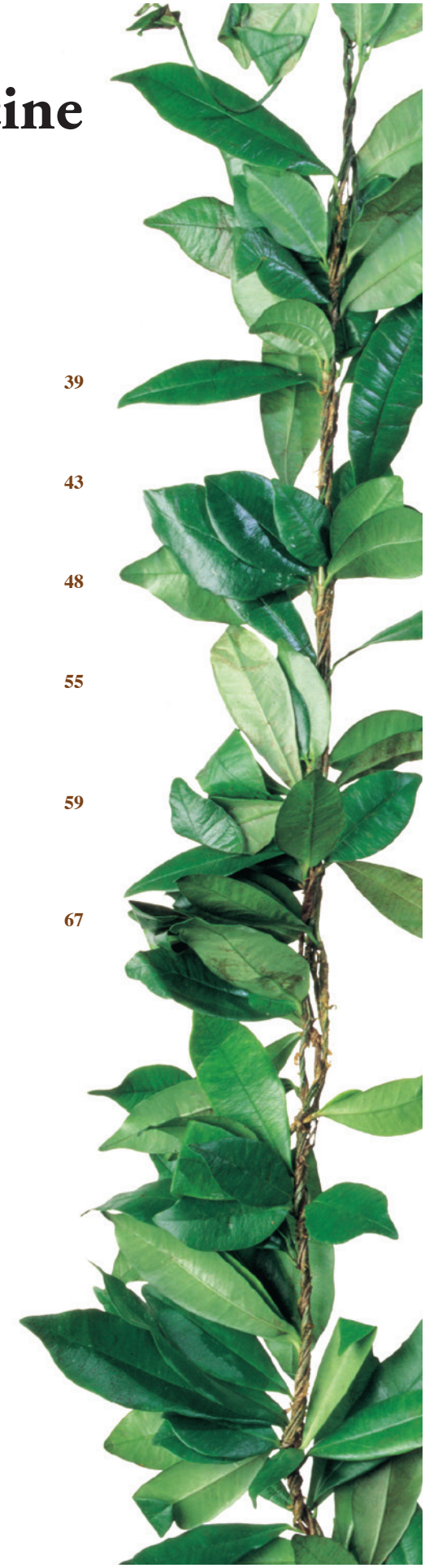

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The Hawai‘i Journal of Medicine & Public Health was formerly two separate journals: The Hawai‘i Medical Journal and the Hawai‘i Journal of Public Health. The Hawai‘i Medical Journal was founded in 1941 by the Hawai‘i Medical Association (HMA), which was incorporated in 1856 under the Hawaiian monarchy. In 2009 the journal was transferred by HMA to University Clinical, Education & Research Associates (UCERA). The Hawai‘i Journal of Public Health was a collaborative effort between the Hawai‘i State Department of Health and the Office of Public Health Studies at the John A. Burns School of Medicine established in 2008.

D. Varez

Major Oncologic Surgery at a Community Hospital

Hollyann Loui; Pouya Benyamini MD; and Gregorio Maldini MD

Abstract

There is a national trend to refer patients requiring complex oncologic surgery to tertiary high-volume cancer centers. However, this presents major access challenges to Hawai'i patients seeking care. The purpose of this study is to demonstrate that complex oncologic surgery can be safely performed at community hospitals like those in Hawai'i. From July 2007 to December 2014, 136 patients underwent complex oncologic procedures at a community hospital in Hawai'i by a single general surgeon. Cases included esophagogastric, hepatobiliary, pancreatic, rectal, and retroperitoneal resections. A database of patients was created from information extracted from the EPIC database. Complications were evaluated using the Clavien-Dindo grading system. There was 0.7% mortality rate (grade V complication). The major morbidity rate was 12.5%, including 10.3% grade III complications and 2.2% grade IV complications. The median length of stay for all operations was 8 days. The mean estimated blood loss for all operations was 708 cc. There was a 2.9% hospital readmission rate within 30 days of initial discharge, and a 5.1% reoperation rate. Complex oncologic procedures can be safely performed at a low-volume community hospital, with outcomes similar to those from high-volume cancer centers.

Introduction

In the past decade increased awareness of surgical quality and outcome monitoring has shown that mortality from complex surgical procedures has declined. Multiple studies have shown that high volume centers and/or surgeon experience produce better surgical outcomes, but there is still wide variation between hospital outcomes.[1] These findings have led to a movement toward performing complex oncologic procedures at tertiary institutions and National Cancer Institute-designated cancer centers. While specialized high-volume centers may seem to be the logical choice for complex surgical procedures, accessibility can be a challenge. For Hawai'i patients, access to specialized high-volume cancer centers located in the continental United States requires travelling long distances, travel expenses, and prolonged stays away from home. Many Hawai'i patients may instead prefer to be treated at a local community hospital. Studies have shown that complex oncologic procedures can be performed safely at low-volume hospitals, with mortality and morbidity statistics consistent with those of high-volume hospitals.[2]

Our objective was to analyze the mortality, reoperation, complications, and readmission rates for all patients who underwent a complex oncologic resection by a single general surgeon at Straub Clinic & Hospital between July 2007 and December 2014. Complex oncologic resections included those of the esophagus, stomach, liver, pancreas, bile duct, colorectal, and sarcoma cancer. Patient outcomes were compared to statistics from high volume cancer centers including Massachusetts General Hospital, Memorial Sloan-Kettering Cancer Center, and MD Anderson Cancer Center to determine whether major oncologic resections can be performed safely at low-volume community hospitals like those in Hawai'i.

Methods

A retrospective review was conducted on all patients who underwent complex oncologic resection by a single general surgeon from July 2007 to December 2014. A "complex oncologic resection" was defined as an oncologic procedure in one of the following categories: esophagogastric, hepatobiliary, pancreatic, rectal, and retroperitoneal resections. More specifically, these procedures included esophagectomies, gastrectomies (total and partial), hepatectomies (major and partial), Whipple procedure, distal pancreatectomies, low anterior resections (laparoscopic and open), abdominoperitoneal resections (laparoscopic and open), Hartmann's procedures, and retroperitoneal mass resections. A total of 136 patients fit the inclusion criteria.

A database was created by retrospectively reviewing patient records through the EPIC database. For each patient the following variables were collected: sex, age, procedure type, estimated blood loss, length of stay, major complications, reoperation, readmission, mortality, anastomotic leak, and fistula. Postoperative complications were evaluated using the established Clavien-Dindo grading system, and complications graded as grades III, IV, or V were considered to be major complications. For each patient, only the single highest grade complication was reported. Readmissions were reported if the patient was readmitted during the first 30 days after discharge. Length of stay (LOS) was calculated from the date of surgery. Estimated blood loss (EBL) was measured in cubic centimeters (cc).

Basic statistics were calculated to determine median length of stay, mortality rates, and complication rates by organ resection type (pancreatic, liver, esophageal, gastric, rectal, and sarcoma). Mortality rates and median length of stay for organ resections of the pancreas, liver, and esophagus were compared to data from Massachusetts General Hospital,[3] Memorial Sloan-Kettering Cancer Center,[4] and MD Anderson Cancer Center, respectively.[5] These centers were chosen for their high volume and because they serve as gold standards for major oncologic resection.

In this study, certain guidelines to ensure surgical quality were followed for all procedures. Except for a limited number of retroperitoneal margins in Whipple procedures, all specimens had free surgical margins. Lymphadenectomy was adequate in all specimens according to National Comprehensive Cancer Network guidelines, and more than 90% of cases were discussed at Tumor Board meetings.

Results

From July 2007 to December 2014, a total of 136 patients who underwent complex oncologic resections were analyzed (Table 1). Of the patients evaluated, 88 (64.7%) were male, average age was 65.6 years, median LOS was 8 days, and mean EBL for all operations was 708 cc (data not shown). During this time period, there were 11 (8.1%) esophagectomies, 17 (12.5%) gastrectomies (major and partial), 33 (24.3%) hepatectomies (major and partial), 25 (18.4%) Whipple procedures, 10 (7.4%) distal pancreatectomies, 20 (14.7%) low anterior resections (laparoscopic and open), 5 (3.7%) abdominoperineal resections (laparoscopic and open), 4 (2.9%) Hartmann's procedures, and 11(8.1%) retroperitoneal mass resections. There was a single mortality from a myocardial infarction on post op day six after an uneventful Whipple procedure. There were 7 patients who required reoperation within 30 days from surgery, for a reoperation rate of 5.1%. Two reoperations were re-explorations secondary to postoperative hypotension after a Whipple procedure and an esophagectomy, both with negative findings. The remaining 5 reoperations were due to biliary stricture after a pancreas-sparing duodenectomy, postoperative hemorrhage after a Whipple procedure, postoperative pancreatitis after a gastrectomy, postoperative small bowel obstruction, and evisceration after a Whipple procedure and nephrectomy. The readmission rate within 30 days of discharge for the entire group was 2.9% (4 patients). The causes for readmission included 2 small bowel obstructions after low anterior resection, fluid collection after low anterior resection, and transient postoperative liver failure after bile duct tumor excision.

Complications

Complications for the entire group were graded using the Clavien-Dindo classification system, and only major complications (defined as grades III, IV, and V) were considered. The overall complication rate was 12.5%, including 14 (10.3%) grade III and 3 (2.2%) grade IV complications (Table 1). There was 1 (0.7%) mortality (grade V). There were 5 (3.7%) fistulas and 0 anastomotic leaks (Table 1).

Operative Details

There were a total of 11 patients who underwent esophagectomies during the study period (Table 1). Two (18.2%) patients had grade III complications. One (9.1%) patient had a thoracic duct fistula. The average age of patients in this group was 66.7 years with a median LOS of 14 days and an average EBL of 682 cc (Table 2).

There were a total of 17 patients who underwent gastrectomies during the study period (Table 1). Within this group, 8 (47.1%) underwent a total gastrectomy and 9 (52.9%) underwent a partial gastrectomy. One (5.9%) patient experienced a grade IV complication, postoperative pancreatitis. The average age of patients in this group was 71.5 years old with a median LOS of 9 days and an average EBL of 721 cc (Table 2).

There were a total of 33 patients who underwent hepatectomies during the study period (Table 1). Within this group, 13 (39.4%) underwent a major hepatectomy, 16 (48.5%) underwent a partial hepatectomy, and 4 (12.1%) underwent a biliary bypass. Four (12.1%) patients experienced grade III complications. The average age of patients in this group was 62.2 years old with a median LOS of 6 days and an average EBL of 773 cc (Table 2).

Of the 35 pancreatic resections, 25 (71.4%) patients underwent Whipple procedures and 10 (28.6%) patients underwent distal pancreatectomies during the study period (Table 1). Within this group, a total of 8 (32%) patients experienced complications. This included 5 (20%) grade III complications, 2 (8%) grade IV complications, and 1 (4%) grade V complications. Three (12%) patients had fistulas after distal pancreatectomies. The average age of patients in this group was 66 years old with a median LOS of 9 days and an average EBL of 1000 cc (Table 2).

There were a total of 29 patients who underwent rectal resections during the study period (Table 1). Within this group, 6 (20.7%) underwent a laparoscopic low anterior resection, 14 (48.3%) underwent an open low anterior resection, 4 (13.8%) underwent a laparoscopic abdominoperineal resection, 1 (3.4%) underwent an open abdominoperineal resection, and 4 (13.8%) underwent a Hartmann's procedure. Three (10.3%) patients experienced grade III complications. The average age of patients in this group was 68 years with a median LOS of 7 days and an average EBL of 360 cc (Table 2).

There were a total of 11 patients who underwent retroperitoneal mass resections during this study period (Table 1). Within this group, no patients experienced complications. The average age of patients in this group was 58.1 years old with a median LOS of 6 days and an average EBL of 504 cc (Table 2).

Median Length of Stay and Mortality

A comparison of mortality rate and median LOS data with data from high volume centers showed comparable results. Because the sample size of this study was 136 and there was only one mortality, median LOS data provides a better comparison with high volume centers. Median LOS data for pancreatic resections was compared to data from Massachusetts General Hospital.[3] Data for hepatic resections was compared to Memorial Sloan-Kettering Cancer Center.[4] Data for esophageal resections was compared to MD Anderson Cancer Center.[5] The numbers were comparable with the exception of a six-day discrepancy for esophageal resections (Table 3).

Table 1. Complications and Mortality							
	Total (N=136)	**Pancreatic (n=35)**	**Liver (n=33)**	**Esophageal (n=11)**	**Gastric (n=17)**	**Rectal (n=29)**	**Sarcoma (n=11)**
Grade 3	14	5	4	2	0	3	0
Grade 4	3	2	0	0	1	0	0
Grade 5	1	1	0	0	0	0	0
Total	18	8	4	2	1	3	0
Fistula	5	3	1	1	0	0	0
Anastomotic Leak	0	0	0	0	0	0	0

Table 2. Operative Details							
	Total (n=136)	**Pancreatic (n=35)**	**Liver (n=33)**	**Esophageal (n=11)**	**Gastric (n=17)**	**Rectal (n=29)**	**Sarcoma (n=11)**
Median LOS (days)	8	9	6	14	9	7	6
EBL (cc)	708	1000	773	682	720	360	504
Reoperation	7	4	0	1	1	1	0
Readmission	4	0	1	0	0	3	0

LOS = length of stay; EBL = estimated blood loss

Table 3. Comparison with High Volume Centers						
Organ Resection	**Pancreas**		**Liver**		**Esophagus**	
Hospital	MGH (n=634)	Straub (n=35)	MSKCC (n=1803)	Straub (n=33)	MD Anderson (n=386)	Straub (n=11)
Mortality (%)	0.5	0.7	2	0	3.1	0
Median LOS (days)	7	9	8	6	8	14

Discussion

For many surgical procedures, high-volume hospitals have lower operative mortality rates than low-volume hospitals. This difference in mortality rates is especially pronounced in complex oncologic surgeries that come with increased risk for mortality like pancreatic, hepatobiliary, gastric, rectal, and retroperitoneal mass resections. Unfortunately for Hawai'i patients, there are no high-volume hospitals in Hawai'i and access to high-volume hospitals located on the continental United States requires long distance travel.

This study included the single mortality when calculating median LOS. As there was only one mortality, LOS data was not significantly affected by this inclusion and no adjustments were made. For higher mortality rates however, LOS calculated without adjustment for mortalities biases the LOS downward. Memorial Sloan-Kettering Cancer Center and MD Anderson Cancer Center both had higher mortality rates than Straub Hospital, and none of the three centers adjusted their median LOS data for mortalities. This may account for some of the discrepancy between Straub Hospital's median LOS data and the LOS data for the three high volume centers.

A study from the New England Journal of Medicine examining operative mortality for 474,108 patients undergoing cardiovascular procedures or cancer resections showed that patients who were operated on at high-volume hospitals had significantly lower mortality rates than those operated on at low-volume hospitals.[6] Mortality rates for esophagectomies were 15.3% and 9.5% for low- and high-volume hospitals, respectively. For pancreatic resections, mortality rates were 11.9% and 4.5% for low- and high-volume hospitals, respectively. In the study, operative mortality was defined as death prior to hospital discharge or within 30 days following major oncologic surgery. High- and low-volume hospitals were defined as those that performed greater or fewer than 13 esophagectomies per year, and greater or fewer than 11 pancreatic resections per year. The outcomes of the study show the risks associated with major oncologic procedures performed at low-volume hospitals, and support the trend to refer patients requiring such surgery to high-volume hospitals. However, the results of this study show significantly lower operative mortality rates than both the high- and low-volume hospitals, despite the fact that this study was conducted at a low-volume hospital. These results support the stance that complex oncologic operations can be performed safely in Hawai'i.

Low case volume presents a large limitation in this study. Because of the small sample size, it was impossible to make meaningful statistical comparisons to the large case volumes from high-volume centers. Moreover, data on minor complications (grades I and II) were not considered, which could have affected median LOS. Data was not collected to generate survival curves, also limiting the study. Data on 90-day readmission was also not collected. A recent study published by the John Hopkins University School of Medicine examining 158,753 patients suggests that 90-day readmission is a more accurate representation of surgical outcomes than the standard, 30-day readmission. Of the 16.5% of cases in their study that required hospital readmission within 90 days of surgery, 6.5% occurred beyond the standard 30-day mark. The study also suggested that fragmented care could be a major cause of readmission, which occurs when patients have a procedure done at one particular hospital, the index hospital, and then are readmitted to another hospital, a non-index hospital. Patients that were readmitted to non-index hospitals had a higher in-hospital mortality rate (2.3%) compared to patients readmitted to index hospitals (0.5%), possibly due to the index hospitals' increased familiarity with the patients, procedures, and care plan.[7] A major advantage for the patients who were readmitted to the hospital in this study was ease of access to the index surgeon who performed their procedure, eliminating the risk associated with non-index hospitalization.

Although it may be logical to receive treatment at specialized cancer centers, access to them is challenging, especially for Hawai'i patients. Because of this difficulty, this study compared major oncologic surgery outcomes between major tertiary cancer centers and data from a single general surgeon at a low-volume hospital in Hawai'i. Despite the limitation of low operation volume, the results showed that complex oncologic surgery can be performed safely in low-volume, community hospitals because of the low major morbidity and mortality rates. Additionally, a comparison with studies conducted at Massachusetts General Hospital, Memorial Sloan-Kettering Cancer Center, and MD Anderson Cancer Center show comparable outcomes for pancreatic, hepatic, and esophageal resections. It is also important to consider that outcomes of complex oncologic surgery are highly dependent on surgeon experience, and complex surgery outcomes at all low-volumes hospitals will not be the same. For all 136 cases reviewed there were no anastomotic leaks, which serves as a surrogate for the quality of surgery performed. While high operation volume is still a surrogate for good surgical outcomes, low-volume hospitals can still produce good results. Hawai'i patients do not necessarily need to travel to seek major oncologic surgery.

In the future, this experiment should be continued in order to collect, review, and analyze a larger number of patients/operations. We could also include other data points such as operative time to help analyze similarities and differences between the hospitals. This would provide a longer term study and allow for more statistically significant comparisons.

Conflict of Interest

None of authors identify any conflicts of interest.

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Atraumatic Spinal Cord Injury in the Novice Surfer: A Comprehensive Review and Update

Christian Swinney BA; David Flick MD; and Moses Cheng DO

Abstract

Novice surfers are at risk for a rare but potentially devastating form of atraumatic myelopathy. There are 16 published studies on this condition, including 66 cases. The most common suggested mechanism of injury is static hyperextension. However, active mechanisms, in contrast to static, have also been proposed and may be contributory. First time surfers, defined as those who have never been on a surfboard prior to the day of injury, are at particular risk. These individuals make up 89.5%-100% of the reported novice surfers found in the various reports. Multiple neurologic deficits occur and often include paraparesis, paraplegia, urinary retention, and hyperesthesia. While these deficits resolve in some cases, there are reports of multiple instances of permanent injury. Increased awareness of this condition is arguably the most effective preventative measure, as it may lead to avoidance of the predisposing postures. It may also lead to earlier diagnosis in the acute setting, which will become relevant as treatment modalities continue to be refined.

Keywords

Myelopathy, Surfing, Hawai'i, Atraumatic, Paraplegia

Introduction

Surfing, a popular recreational activity in the Pacific Region, is associated with a significant risk of injury. It has been linked to the development of multiple neurological insults, many of which have significant long term sequelae.[1-12] Review of the current body of literature shows damage can be sustained to multiple regions, including the brain, spinal cord, and external head/neck region. Of these injuries, those to the spinal cord may be particularly devastating, leading to significant morbidity and functional impairment.

The first major examination of nontraumatic surfing-related spinal cord injury was conducted in Hawai'i by Thompson in 2004. Thompson developed the term "surfer's myelopathy" to describe an atraumatic spinal injury in the novice surfer.[2] His five year retrospective study included nine patients who presented to a Hawai'i hospital with atraumatic back pain, following an initial surfing experience. Notable demographic features of these patients included that the majority were male (8/9), Japanese (8/9), and had no prior surfing experience (9/9). The most common presenting symptoms were paraparesis (8/9), urinary retention (8/9), anesthesia (3/9), and hyperesthesia (2/9). Outcomes in Thompson's original study varied. Three of the patients had a complete recovery, four had continued mild weakness without sensory deficits, three had residual urinary retention, and one remained paraplegic. Thompson's original study is significant in that it illuminated a previously unreported condition and led to multiple subsequent case series and cases reports, which we have analyzed herein.

Including Thompson's original study, there are a total of 66 reported cases of surfer's myeolopathy, spread across 16 publications.[2,13-27] Although there is some variation among these clinical cases, the patients tend to share similar mechanisms of injury, radiographic findings, and natural histories, suggesting a common disease process. The disease entity, which almost exclusively impacts novice surfers, is a result of radiographically identifiable ischemia to the spinal cord.[11] The associated morbidity is often substantial.[13-27]

While cases of surfer's myelopathy are widely reported in the scientific literature, there are a limited number of comprehensive reviews. Various mechanisms of injury have been proposed, but they are poorly understood and there is no consensus. This, in turn, has likely contributed to the relatively limited discussion of preventative measures. Given this dearth of evidence, further investigation into the mechanism of injury and preventative measures are warranted. Herein, we present a novel assessment of this disease process, which is highly relevant to the people of Hawai'i and the Pacific Islands. It is our genuine hope that an increased awareness of both the incidence and mechanism of surfer's myelopathy will enable surfing enthusiasts to provide more effective prevention education and physicians to provide more effective acute management.

Methods

Objective

The object of our study was to evaluate a potentially devastating disease process relevant to recreational surfers, especially those in Hawai'i and the Pacific Islands.

Search Strategy

A comprehensive review of the literature was performed. The PubMed (MEDLINE), Google Scholar, and EMBASE databases were searched up to May of 2016. The first recorded reference was noted in January 2004. The search strategy utilized relevant keywords to find applicable articles. These included myelopathy, surfing, Hawai'i, atraumatic, and paraplegia. The titles of all articles within the period of eligibility were searched for the following terms: surfer's myelopathy, surfing, and atraumatic myelopathy.

Selection of Studies and Data Extraction

Inclusion criteria were broad and any case reports or case series that specifically addressed the aforementioned condi-

tion, "surfer's myelopathy," were evaluated. General trends, including age of onset, presenting symptoms, treatments, and residual deficits, were recorded on a case-by-case basis. Articles originally written in English, as well as translated non-English articles, were considered.

Data Analysis

Data was collected and analyzed using Microsoft Excel 2013. Our descriptive analysis reviewed the frequency of various features associated with the condition. Given the nature of this review, statistical significance was not deemed applicable and thus not evaluated.

Results

A comprehensive search revealed 16 published papers detailing 66 separate cases (Table 1). A total of 42% of the reported cases occurred in Hawai'i. Of the 16 studies, 4 were in the form of a case series, which ranged in size from 3 to 23 patients. The remaining studies were individual case reports. It should be noted that the discussion of surfer's myelopathy in the literature is a relatively recent phenomenon, with a majority of cases (85%) reported after 2009. The primary risk factor for the development of surfer's myelopathy was being a novice surfer, generally defined as someone whose initial surfing experience had been in the preceding month. All reviewed papers (16/16) alluded to this. The term novice was more specifically defined as a "first-time" surfer in some studies.[13,18,21,27] Of particular relevance is a large cases series from Queen's Medical Center in Hawai'i, which reported that 17 of 19 patients (89.5%) were true "first-time" surfers, with absolutely no prior experience.[27] Among the studies, the age at the time of injury ranged from 15 to 37. The chief presenting complaints varied among the studies and included various forms of pain, motor impairment, sensory impairment, and urinary dysfunction. A comprehensive list is as follows: lower back pain, paraparesis, urinary retention, paraplegia, hypoalgesia, and hyperesthesia. The most commonly proposed mechanism of injury was prolonged hyperextension, mentioned in 100% (66/66) of cases. Reported outcomes ranged from complete resolution of the presenting neurologic deficit, to no resolution with extended follow-up. Residual symptoms were common and no improvement was noted in multiple cases. Signs of thoracic spinal cord ischemia on MRI were commonly noted (Figure 1). Specific findings, which commonly included T2 MRI thoracic hyperintensities, were reported in patients presenting with suspected surfer's myelopathy in some radiographic analyses.[16] Changes on T1 MRI imaging were not noted in any of the cases. Treatment regimens varied and were not always specified, but included combinations of steroids (methylprednisolone), intravenous immune globulin (IVIG), aggressive hydration, and CSF drainage.

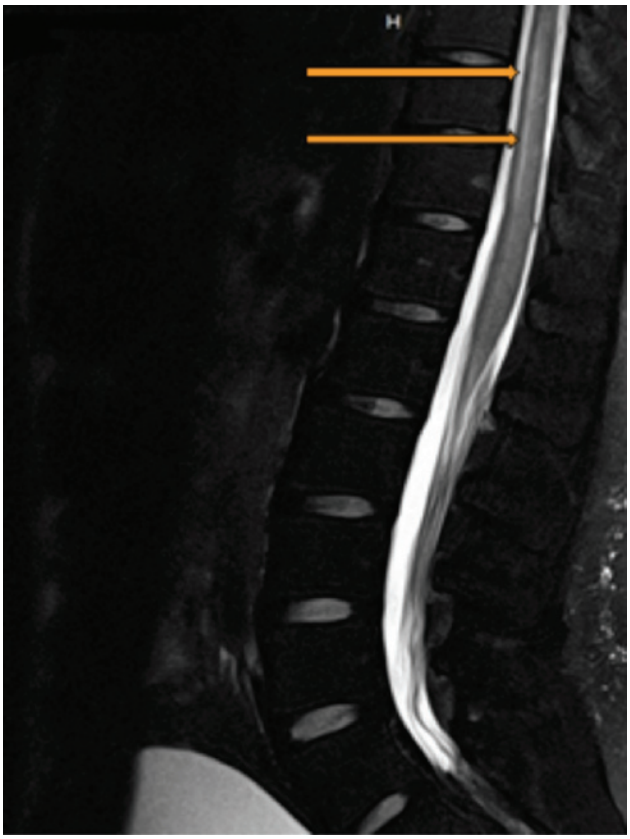

Figure 1. Gray Matter Hyperintensity in the Thoracic Cord

Discussion

The incidence of head, neck, and spine injuries among surfers is significant, occurring in up to 37% of this population.[1,3,5] Classically, surfing related injuries are separated into 2 general categories, traumatic and atraumatic. [3-9] Common mechanisms for traumatic injuries include unintentional impact with the surfboard, other surfers, and the ocean floor.[5-9] While trends in traumatic injuries are well defined, less information exists on non-traumatic injuries.

A specific term, "surfer's myelopathy," is used by many in the medical community to describe spinal deficits resulting from surfing related injury. The term was first used by Thompson in 2004 to describe a series of atraumatic myelopathies noted in surfers in the Hawaiian Islands.[2] His original case series, which included 9 patients, was the first of multiple reports on this condition. Our review of the literature validates that atraumatic surfing-related spinal cord injuries, termed "surfer's myelopathy," are indeed a relatively common source of morbidity affecting novice surfers, with 66 cases described in the literature thus far. Given the predilection of this condition for the inexperienced surfer, awareness of the disease becomes particularly relevant in tourist destinations, such as Hawai'i and the Pacific Islands, where many vacationers may seek to learn the sport, often for the first time. An understanding of the mechanism that leads to this condition is imperative for clinicians. The majority of cases involve the insidious onset of symptoms after a period of prolonged prone hyperextension, a static action. However, another distinct mechanism, which is active as opposed to static, has also been

Table 1. Reported Cases of "Surfer's Myelopathy"						
Year	**Type**	**Patients**	**"First-Time" Clearly Specified**	**Reported Symptoms**	**Proposed Mechanisms**	**PMID[a]**
2004	Case Series	9b		Low back pain, paraparesis, urinary retention, paraplegia, hyperesthesia		15303045
2007	Case Report	1		Low back pain, bilateral leg numbness, paresthesia	Prolonged hyperextension	17684897
2010	Case Report	1		Low back pain, paraplegia, paresthesia, anesthesia, bladder dysfunction	Prolonged hyperextension	20963461
2011	Case Report	1		Low back pain, paraparesis, hyperesthesia		21317134
2011	Case Report	1		Low back pain, weakness, sensory changes, urinary retention		21955419
2011	Case Report	1	Yes	Low back pain, paraplegia	Prolonged hyperextension, hyperextended valsalva	21196015
2011	Case Report	1		Low back pain, paraparesis, paraplegia	Prolonged hyperextension	21765307
2011	Case Report	1		Low back pain		21320847
2012	Case Report	1	Yes	Low back pain, paraparesis, hyperesthesia		22544059
2012	Case Series	19*	Yes	Low back pain, numbness, paralysis		23152585
2013	Case Report	1		Low back pain, paraplegia	Abnormal posturing	22019977
2013	Case Series	3		Low back pain, paraplegia, bladder dysfunction	Prolonged hyperextension, repeated flexion/ extension of spinal column	22257974
2015	Case Report	1	Yes	Low back pain, bladder dysfunction, paraplegia, paresthesia, anesthesia		26394636
2015	Case Series	23		Low back pain, paraplegia, sensory abnormalities, urinary retention		23828111
2016	Case Report	1	Yes	Low back pain, weakness, paralysis, bladder dysfunction		27012110
2016	Case Report	1	Yes	Low back pain, paresthesia, paralysis, bladder dysfunction		27082966
Total		66	6			

[a]PMID is the unique identifier number used in PubMed.
[b]Hawai'i-Based Study

reported. In the original case series by Thompson, there were two patients who reported symptom onset while attempting to stand up on the surfboard. Interestingly, this occurred in one patient while he was practicing his technique on the shore, not in the water. Other studies have suggested that repeated active flexion/extension, rather than prolonged static extension, may lead to ischemia and subsequent deficit.[14,15] Thus, there are at least two proposed mechanisms, which are fundamentally different, which may lead to the same clinical outcome.

In terms of a specific pathophysiological mechanism of these injuries, it has been postulated that ischemia to the spinal arteries may be contributory.[11] It is possible that holding a sustained hyperextended position may contribute to ischemia and subsequent infarction of watershed areas that share perfusion between the anterior and posterior spinal circulation. This mechanism seems particularly reasonable in the cohort of patients who report prolonged passive hyperextension without any acute active events. Other possible mechanisms of injury include avulsion of perforating vessels, vasospasm of the artery of Adamkiewicz, and fibrocartilagenous embolism.[11] These mechanisms seem to be more applicable to the few patients reporting acute onset of back pain during active motion. In terms of predisposing factors, Thompson suggests that the unconditioned back muscles of the novice surfer may pose a particular risk for back injury and subsequent infarction.[2] It has also been suggested that novice surfers spend more of their idle time in the prone hyperextended position, compared to their more experienced counterparts, who sit upright. This idle time makes up a notable proportion of a surfing experience. In fact, time motion analyses have revealed only 4%-5% of the total time of surfing involves wave riding.[12] The majority is spent paddling (50%) and idling (40%). Thus, this may contribute to increased risk in novice surfers.

Further exploration of the pathophysiological mechanisms and treatment modalities associated with this condition is warranted. No standard treatment has been proposed and outcomes have varied substantially. Therapeutic options have included aggressive hydration, high-dose steroids, induced systemic hypertension, and CSF drainage, but there is no data-based consensus at this time.

Various preventative measures may help decrease the morbidity associated with this condition. These include public service announcements, as well as other means of increasing awareness among physicians, novice athletes, and surfing schools. An appreciation of the role of prolonged hyperextension, the most agreed upon mechanism of injury in the development of this condition, may enable the physician to more effectively educate the patient on proper technique. This recommendation could be supplied to organizations that provide surfing instruction, which often provide novice surfers with equipment and guidance. This is particularly relevant in Hawai'i, where these companies are ubiquitous. These organizations could encourage novice surfers to sit upright in the seated position while idling, as opposed to the prone hyperextended position. Increased awareness among physicians of the prevalence of this disease process may also lead to increased study and understanding of the presenting symptoms, natural history, and treatment options. This has the potential to translate into both more informed patient care, as well as additional research. There are various directions that additional research could take, including improved equipment/surfboard design and the impact of specific stretching/strengthening routines. Given the proposed impact of inexperience on the disease process, an observational study comparing novice and experienced surfers may also prove insightful. It should also be noted that not all studies reported concrete numbers when describing presenting symptoms, outcomes, and imaging results. This made it difficult to quantify their otherwise subject observations, a possible limitation of the present study.

It is quite possible that strengthening of the paraspinal musculature may decrease the risk of ischemia. This suggests that a preparatory exercise regime, based around core strengthening, should be considered prior to any initial attempts at surfing. Again, these recommendations could be provided by surfing instructors and schools, as well as to physicians. First time surfers should also be counseled to immediately stop surfing at the first sign of back pain. It is reasonable to assume that many of the affected individuals dismissed the initial lower back pain as musculoskeletal in origin, thereby unknowingly prolonging ischemia to the region. Lower back pain in the novice surfer is a potentially ominous warning sign that warrants cessation of activity.

Conclusion

Novice surfers are at risk for a rare, but potentially devastating form of atraumatic myelopathy. The most commonly suggested mechanism is static hyperextension, but active mechanisms have also been proposed. Neurologic deficits may resolve, but have the potential to be permanent. Increased awareness of this condition is arguably the most effective preventative measure, as it may lead to avoidance of the predisposing postures. It may also lead to earlier diagnosis in the acute setting, which will become relevant as treatment modalities continue to be refined.

Conflict of Interest

None of the authors identify a conflict of interest.

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Awareness of Gestational Diabetes and its Risk Factors among Pregnant Women in Samoa

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Abstract

Gestational diabetes mellitus (GDM) is a subtype of diabetes mellitus defined as the development, or first recognition, of glucose intolerance during pregnancy. The risk of developing type 2 diabetes mellitus (T2DM) is greater in mothers with GDM compared to the general population. Preventing the development of GDM could help lower the prevalence of T2DM and long-term morbidity in children of affected mothers. The purpose of this study was to investigate the awareness of GDM and its risk factors among pregnant women in Samoa, exploring where participants obtained information, and understanding their attitudes towards diet and physical activity. A quantitative cross-sectional study of 141 women attending Tupua Tamasese Meaole (TTM) hospital in Apia, Samoa in May 2015 was performed. Fifty-eight percent women were aware diabetes can occur for the first time during pregnancy. The greatest information source was from doctors (37%, n=44) followed by family members (22%, n=28), based on 118 respondents. Only one woman correctly identified all four risk factors for GDM. Most women recognized eating a healthy diet (79%) and regular physical activity (78%) to be appropriate lifestyle changes to help prevent GDM. These findings suggest awareness of GDM among pregnant women in Samoa is mixed, with a very small proportion having good knowledge (based on the number of risk factors identified). We conclude that increased education about GDM is necessary, both in hospital clinics and within the community. By increasing awareness of GDM, it may be possible to decrease the prevalence of T2DM in Samoa.

Keywords

Diabetes, gestational, awareness, attitude, Samoa

Abbreviations:

FH = family history
PMH = past medical history
DM = diabetes mellitus
GDM = gestational diabetes mellitus
T2DM = type 2 diabetes mellitus
TTM = Tupua Tamasese Meaole

Introduction

Non-communicable diseases pose a large health threat to Samoa. The prevalence of diabetes mellitus (DM) in women is estimated to be 26.6%,[1] and 64.6% of Samoan women were found to be obese.[2] The World Health Organization attributes obesity and type 2 diabetes mellitus (T2DM), to a large extent, to high-level consumption of calorie-rich, nutrient-poor, imported food and a lack of physical exercise.[3] Gestational diabetes mellitus (GDM) is a subtype of DM and is defined as glucose intolerance with onset or first recognition during pregnancy.[4] It is associated with pre-eclampsia for the mother and a higher risk of birth injury, macrosomia, neonatal hypoglycaemia, respiratory distress syndrome, polycythaemia, jaundice, and hypocalcaemia in infants.[5,6] Long-term morbidity for children of affected mothers includes an increased risk of obesity, T2DM, metabolic and cardiovascular complications.[7] Furthermore, the risk for a mother with GDM of developing T2DM is 18.9%, nine years after delivery,[8] compared to 2% in non-GDM women.

The highest risk factors for GDM are high maternal age, family history of T2DM, being overweight prior to pregnancy,[9] excessive gestational weight gain, and a past history of GDM/glucose intolerance.[10] Diet and lifestyle can control glucose tolerance in GDM and have been associated with lower birth complications.[11] Determining awareness about GDM and its risk factors may lead to improved self-care and help its prevention. Identifying the source of patient knowledge helps understand where patients currently obtain most healthcare advice. In response to the alarming trends of obesity and its complications, the Samoan Ministry of Health made a goal of their Health and Nutrition Policy 2013 to "Promote healthy eating and lifestyles." Investigating patient awareness of diet and lifestyle is useful to help gauge the effectiveness of the Samoan Ministry of Health's campaign to promote healthy eating and lifestyles,[2] potentially identifying further areas to target. In particular, information on lifestyle practices can help doctors to tailor advice given to patients and determine whether those patients who are informed carry out healthy lifestyle practices.

There is no prior literature to assess the awareness of GDM in pregnant women in Samoa. Similar studies have been conducted in South India and Australia;[12,13] however these studies did not additionally investigate patients' attitudes towards diet and physical activity. Although a separate study investigating the attitudes towards physical activity in pregnancy in Samoan women was conducted in 2007, this was not in the context of GDM.[14] Therefore research on knowledge and attitudes about GDM among women in Samoa is required.

The aims of this study were to assess the current level of awareness of GDM and its risk factors among pregnant women in Samoa. The source of women's knowledge was investigated to understand how health promotion could be best targeted. Furthermore, attitudes towards healthy diet and regular physical activity, in relation to preventing GDM, were explored.

Method

A quantitative cross-sectional study of pregnant women attending antenatal clinics in Tupua Tamasese Meaole (TTM) hospital in Apia, Samoa was performed. TTM hospital has 200 beds[15] and is the main hospital in Samoa, serving a population of 193,483.[16] It is supported by eleven smaller district hospitals/health centres located on both islands which are staffed periodically

by a visiting doctor from TTM hospital. TTM hospital is the only location where antenatal clinics are held for all women in Samoa from both islands. These are conducted on Tuesday and Thursday mornings; a nurse-led clinic and doctor-led clinic run alongside each other. The World Health Organisation estimates that 93% of women in Samoa receive antenatal care at least once during their pregnancy,[17] and 58.4% receive at least four antenatal visits.[19] It is hoped that data collection at antenatal clinics in TTM hospital will sample a large proportion of the population. However, a significant proportion will be missed as many do not frequently attend for antenatal care reviews. IRB approval was not obtained. Ethical approval was obtained from the University of Birmingham's Ethical Research committee and the Ministry of Health, Samoa. Data collection took place in May 2015.

The questionnaire was modelled after work by Shriraam, et al,[12] who administered a pre-tested questionnaire, consisting of 12 questions, to pregnant women attending an antenatal clinic in South India. This questionnaire investigated background characteristics, knowledge of T2DM and GDM, in addition to the source of their knowledge. Supplementary questions regarding diet and exercise were included as appropriate to this study; these questions were not modelled on another validated questionnaire. A pilot study of the questionnaire was not performed.

The questionnaire collected background information on participant's age, self-reported height and weight, stage of pregnancy, parity, and previous history of DM/GDM or birth complications. This was followed by 10 questions investigating the participant's awareness of GDM, its risk factors, and the source of knowledge about GDM. Participants' attitudes towards diet and lifestyle, in the context of helping to prevent GDM, were also explored as well as their dietary habits and level of physical activity.

Awareness of the risk factors of GDM was assessed by knowledge of pre-pregnancy obesity, rapid weight-gain during pregnancy, family history, and a past history of GDM. Patients were asked to tick the box by each factor if they thought this was a risk factor. If a participant ticked the boxes, this implied knowledge about risk factors. Participants were deemed to have good knowledge if they correctly identified all four risk factors. The questionnaire asked about the source of knowledge regarding these risk factors; patients were asked to choose all sources that applied to them from the list. Further sources could also be listed by the patient.

Attitudes toward diet and lifestyle were assessed by asking participants whether a healthy diet and regular physical exercise could help prevent GDM. The options "yes", "no", and "don't know" were given; "yes" was considered the correct answer. Participants were asked how many times per week they exercised; the options of 0, 1-2, 3-4 and >5 were given. The questionnaire collected data on types of exercise performed; the options provided were "jogging", "dance", "swimming", "team sports", and "stretches/weights training", with an option of "other" given to record additional options not provided in tick boxes. Dietary habits were briefly assessed by asking patients whether they regularly ate processed foods or foods high in sugar. The options of "yes", "no" and "don't know" were given. The number of portions of fruit and vegetables eaten every day was also asked and participants could select 0, 1, 2, 3, 4, 5+.

Convenience sampling with inclusion and exclusion criteria was used to collect data. All pregnant Samoan women attending antenatal clinics aged over 18 years were included in this study. Questionnaires were excluded if only the background demographic variables were completed. No other inclusion/exclusion criteria were used for this study.

Questionnaires were completed by participants while waiting for their clinic appointment. After written informed consent was obtained (Appendix 1), a questionnaire was completed by participants (Appendices 2 and 3). These were then collected by the principal investigator and stored in a sealed container. The questionnaires were translated into Samoan by a medical student studying at the National University of Samoa and the principal investigator was available throughout the clinic to answer any questions about completion of the questionnaire.

Data Analysis

All data were analysed in SPSS (IBM, California, USA) using descriptive statistics. To compare data we used analysis of variance tests for continuous variables and χ^2 tests for categorical variables. We used log-binomials models with generalized estimating equations to estimate relative risks and 95% confidence intervals. Generalized estimating equations allowed us to account for correlations among repeated observations (GDM) contributed by a single participant.

Results

A total of 149 women initially participated in the study. Four participants were excluded as they did not complete any questions and 4 women did not answer question 6 regarding awareness of gestational diabetes. The final analysis includes responses from 141 women. Many participants did not answer all questions in the questionnaire but were still included, hence there is some variation in response numbers for each aspect analysed.

Background Demographics

The median age of women in the study was 26 years (18-49 years). Eighty-five percent (n=101) were 29-40 weeks pregnant and 27% (n=37) of the women were primaparous (Table 1). Four women stated they had a past medical history of T2DM and 9.6% (n=13) of gravid mothers stated they had a past medical history of GDM. Fourteen women reported previous birth complications (13%); preterm labour and macrosomia were the most common complications, followed by low birth weight and still birth. Of those who described a past history of GDM, two had birth complications; both had preterm labour.

Awareness of GDM

Knowledge of GDM among women in Samoa was mixed. Fifty-eight percent of patients (n=82) were aware that diabetes can occur for the first time during pregnancy, 23% (n=32) were

unsure, and 19% (n=27) did not think that it could (data not shown). Only one woman identified all four risk factors for GDM (Tables 2 and 3). Of those who were aware gestational diabetes can occur for the first time during pregnancy, 49% (n=40) identified a family history of GDM as a risk factor (Table 4). The second most commonly recognized GDM risk factor was pre-pregnancy obesity; 23% (n=19) of women identified this. Those aged 18-22 appeared to have the greatest awareness of gestational diabetes (61%; n=86), while those aged 33-37 had the lowest level of awareness (39%; n=55) (Table 5). This was of moderate significance (Pearson's correlation = -0.613; $P<.001$).

Participants attributed a variety of sources for their awareness of GDM. Doctors were the largest source of information (37%; n=44), followed by family members (24%; n=28) and the television/radio (22%; n=26) (Table 6). Less commonly reported sources were other types of healthcare workers (eg, nurses and midwives), friends, posters, newspapers/magazines, and the internet.

The strongest predictor of GDM awareness was identification of past family history of DM as a risk factor ($P<.001$, ANOVA) (data not shown). Knowledge of pre-pregnancy obesity as a risk factor also strongly correlated with GDM awareness (Pearson's correlation = 0.977; $P<.001$); however, knowledge about rapid weight gain during pregnancy and past history of GDM did not reach statistical significance.

Awareness and Attitudes Towards Lifestyle Measures

With regards to awareness and attitudes towards diet and exercise as strategies to help prevent GDM, ninty-nine women (79%) identified eating a healthy diet and 106 women (78%) identified regular exercise as appropriate lifestyle changes (Table 7). One hundred thirty-three women stated that they exercised at least once a week through dance (45%, n=60), walking (31%, n=42), or swimming (23%, n=31) (Table 8). With regard to dietary habits, only 37% (n=46) of women stated they ate at least five portions of fruit and vegetables each day, whilst 71% (n=89) stated they did not eat a diet high in processed foods and sugars (Table 7).

Table 1. Baseline Characteristics

Determinants	Number of Women (N=141)	Proportion (%)
Gestation		
First trimester (weeks 1-12)	2	2
Second trimester (weeks 13-28)	16	13
Third trimester (weeks 29-40)	101	85
Unknown/missing	22	-
Parity		
Primiparous	37	27
Multiparous	101	73
Unknown/missing	3	-
Past Medical History of T2DM		
Yes	4	3
No	131	95
Don't know	3	2
Unknown/missing	3	-
Past Medical History of GDM		
Yes	13	10
No	115	87
Don't know	4	3
Unknown/missing	9	-
Previous Birth Complications		
Yes	14	13
No	96	87
Unknown/missing	31	-
Birth Complication (n=14)		
Macrosomia	4	29
Small for gestational age	2	14
Preterm labour*	7	50
Stillbirth*	2	14

Percentages do not include unknown/missing. Note. T2DM = type 2 diabetes mellitus. GDM = gestational diabetes mellitus. *n=1 participant had both of these complications.

Table 2. Risk Factors for GDM Identified by Participants

Risk Factor Identified	Number of Women (N=141)	Proportion (%)
Pre-pregnancy obesity	32	25
Rapid weight gain in pregnancy	20	16
Family history of diabetes mellitus	60	48
Past history of gestational diabetes	19	15
Don't know	1	1
Unknown/missing	15	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 3. Number of Risk Factors for GDM Identified by Participants

Number of Risk Factors Identified	Number of Women (N=141)	Proportion (%)
0	1	1
1	121	96
2	3	2
3	0	0
4	1	1
Unknown/missing	15	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 4. Risk Factors for GDM Identified by Those Aware of GDM

Risk Factor Identified	Number of Women (n=82)	Proportion (%)
Pre-pregnancy obesity	19	23
Rapid weight gain in pregnancy	12	15
Family history of diabetes mellitus	9	11
Past history of gestational diabetes	40	49
Unknown/missing	6	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 5. Number of Women Aware of GDM According to Age Group		
Age Group	**Number of Women (N=141)**	**Proportion (%)**
18-22	22	61
23-27	21	51
28-32	19	58
33-37	7	39
38-42	9	47
43+	1	50
Unknown/missing	0	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 6. Sources of Information about GDM Identified by Participants		
Source of Information	**Number of Women (N=141)**	**Proportion (%)**
Doctor	44	37
Family	28	24
TV/radio	26	22
Healthcare worker	19	16
Healthcare posters	14	12
Newspapers/magazines	8	7
Friends/neighbours	3	3
Internet	2	2
Don't know	1	1
Unknown/missing	23	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 7. Awareness and Attitudes Towards Preventative Lifestyle Measures for GDM		
Determinant	**Number of Women (N=141)**	**Proportion (%)**
Knowledge of Healthy Diet as a Preventative Measure		
Yes	99	79
No	8	6
Don't know	19	15
Unknown/missing	15	-
Knowledge of Regular Physical Activity as a Preventative Measure		
Yes	106	78
No	9	7
Don't know	21	15
Unknown/missing	5	-
Number of Portions of Fruit and Vegetables Eaten		
0	0	0
1	2	2
2	21	17
3	35	28
4	20	16
5+	46	37
Unknown/missing	17	-
Self-reported Diet High in Processed Foods and Sugars		
Yes	21	17
No	89	71
Don't know	15	12
Unknown/missing	16	-

Percentages do not include unknown/missing. GDM = gestational diabetes mellitus.

Table 8. Type of Physical Activity Performed by Participants		
Type of Physical Activity	**Number of Women (N=141)**	**Proportion (%)**
Dance	60	45
Walking	42	31
Swimming	31	23
Housework	7	5
Running	5	4
Sports	5	4
Stretches	1	1
Unknown/missing	7	-

Percentages do not include unknown/missing.

Discussion

A majority of women (58%) were aware of GDM and only one woman was able to identify all 4 risk factors for GDM. A number of sources of this knowledge were identified; doctors (37%), family members (24%), and television/radio (22%) were the 3 most commonly reported. Seventy-nine percent and 78% of women recognised that regular exercise and a healthy diet respectively were measures to help prevent GDM. This knowledge appears to translate into practice to some degree, as 94% of women stated they exercised at least once per week and 71% said they did not eat a diet high in processed foods and sugars. Thirty-seven percent of women said they eat at least five portions of fruit and vegetables per day. While the study indicates that women believed their diet to be fairly healthy, fast food and imported Western food with little nutritional value are largely consumed by Samoans.[18]

Although doctors were the largest source of knowledge regarding GDM, this was only observed in around one third (37%) of questionnaires. Surprisingly, an even smaller proportion (16%) stated that healthcare workers (nurses and midwives) were a source of information, which is concerning as all pregnant women are strongly encouraged to visit the nurse-led antenatal clinics held at TTM hospital. It is a recognised issue that many women present to antenatal clinics late in their pregnancy; the Demographic and Health Survey 2009 states 13% of women receive antenatal care in their first trimester.[19] Evidence suggests this is because they feel well and do not perceive a need to present earlier.[20] The study reflects this, as over 80% of women were in their third trimester. Doctors are attempting to tackle this issue by visiting women in the communities to encourage them to attend their 12-week scan, with the incentive that they can learn the sex of their baby (personal observations). However, there is a current shortage of doctors in Samoa[21] and district hospitals/health centres are visited only on a weekly basis by doctors,[16] resulting in busy clinics with little time to address health education.[21]

Other reported sources of knowledge were television and radio (22%) and healthcare posters (12%), suggesting messages supported by the Ministry of Health are having a limited

impact. Further development and distribution of these resources could be implemented to educate women and encourage earlier antenatal clinic attendance in order to improve awareness.

Strengths and Limitations

This is the first quantitative study to assess the awareness of GDM among pregnant women in Samoa and also investigate their attitudes towards and implementation of healthy lifestyle practices. The study findings can help guide areas where healthcare promotion should be targeted in Samoa.

There are limitations to the significance of this study. Firstly, this is a cross-sectional study that took place over a one-month period, providing a limited view of Samoan women's perceptions. Additionally, limiting the sample population to clinics at TTM hospital may miss a significant proportion of women, as many women from outside the Apia urban area will find the clinics difficult to attend. The DHS report states 89% of women from Savaii receive antenatal care, compared to 93.5% in the Apia urban area. This could result in women attending fewer antenatal appointments, or not attending altogether. Given that the largest source of knowledge on this subject was reported to be doctors, it may mean these findings are biased and not generalizable outside the Apia urban area. The degree to which participants understood questions is under dispute, as 31% of women who stated a past history of GDM later said they were nulliparous. This could either indicate errors in translation or highlight a lack of understanding of what GDM is; therefore, caution should be used when interpreting the findings of this study. A pilot study was not performed because of time constraints; however, there were no queries from participants during distribution or collection of the questionnaires. Even so, the data collected can still be of use as the results detected large disparities.

Recommendations

Awareness of GDM among pregnant women in Samoa is mixed; only a very small proportion has good knowledge and a large number are not aware of what it is. With a very high prevalence of obesity and diabetes, it is likely to continue to be a relatively common problem facing Samoan healthcare professionals. Therefore, continuing educational strategies are of the utmost importance. As relatively few women had seen government advertisements, this could be an area for future development.

In addition, women are still not visiting antenatal clinics until late in pregnancy, meaning that there is little opportunity to educate patients on GDM and how they can help to prevent it. While doctors are proactively attempting to change this, the results of this study indicate that continuing education is necessary to improve awareness of GDM, as it appears only 58% of pregnant women are aware of the condition. This could be an area to target with public health campaigns. Television and radio messages to encourage women to visit antenatal clinics could also be used in addition to the provision of leaflets and posters.

The largest proportion of women obtained information regarding GDM from doctors. Thus, it is important to ensure that adequate clinic time is always allocated to educate women; this could involve funding additional clinics. Alternatively, introducing education sessions while visiting village clinics could further educate the public.

Early education before pregnancy is likely to be important. With detailed information leaflets and posters already available in the Ministry of Health building, distribution of these in schools and other communities, such as church groups (most Samoans are affiliated to a church parish) could be an effective method to raise awareness.

Further research exploring this population's diet and lifestyle would be beneficial. Participants in this study disclosed that they considered diet and exercise to be important. Therefore, it would be interesting to observe to what extent this is mirrored in their lifestyle.

Conclusions

The high prevalence of obesity and diabetes means GDM is likely to continue to be a relatively common problem facing Samoan healthcare professionals. Women are still not visiting antenatal clinics until late in pregnancy, providing little opportunity for education about GDM and appropriate lifestyle changes that can be made to help prevent it; as well as to managing other health issues. While doctors are proactively attempting to change this, the results of this study indicate that continuing targeted education is necessary to improve awareness of GDM.

Conflict of Interest

None of the authors report any conflicts of interest.

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Appendix 1

Consent Form

This consent form is for women who attend the antenatal clinic at Tupua Tamasese Meaole hospital, and who I am inviting to take part in research on the awareness of and attitudes towards risk factors for gestational diabetes.

The title of the project is: Gestational diabetes in Samoa: A study of pregnant women's awareness of risk factors and their attitudes towards nutrition and physical activity.

Name of principal investigator:
Lucy Price, 4th year medical student at University of Birmingham medical school, England, UK.

I am Lucy Price, a 4th year medical student from England. I am doing research on the awareness and attitudes of risk factors for gestational diabetes. Gestational diabetes is a condition that develops during pregnancy when the pregnant woman develops high blood sugar levels.

This research will involve completing the questionnaire attached, consisting of 15 questions. You do not have to answer all of the questions. Your participation in this research is entirely voluntary and it is your choice whether to take part or not. Question 4 contains sensitive subject matter (miscarriage and stillbirth). If this question is distressing, please do not answer. The information collected will be anonymous.

If you have any questions please come and speak to me or ask a member of staff who can find me. If you have any questions about gestational diabetes please talk to your doctor about this.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant _____
Signature of Participant _____
Date _____
Day/month/year

Appendix 2

Questionnaire - English Version

Age: _____ years Height: _____ cm Weight: _____ kg
Stage of pregnancy _____ weeks
Are you a registered citizen of Samoa? Yes_____ No_____
Please tick the correct box for each question below.
1. Have you ever been diagnosed with type 2 diabetes mellitus? Yes_____ No_____ Don't know_____
2. Have you ever been diagnosed with gestational diabetes? Yes_____ No_____ Don't know_____
3. Do you already have children? Yes_____ No_____
4. If yes to Q3, were there any birth complications? Tick all that apply.
None_____ Small size baby_____ Large size baby (> 9 pounds)_____ Pre-eclampsia_____
Premature birth_____ Preterm labour_____ Still birth_____ Other (please explain)_____
5. Do any of your close family members have, or have had, type 2 diabetes? Yes_____ No_____
Include immediate blood relatives only, not cousins or spouse/partner.
6. Can diabetes occur for the first time during pregnancy? Yes_____ No_____ Don't know_____
7. What do you think are the things that cause a person to develop gestational diabetes? More than one box can be ticked.
Being overweight before getting pregnant_____ Gaining lots of weight during pregnancy_____
Past history of gestational diabetes_____ Family history of diabetes_____
8. What source(s) did you learn your answers to Q7 from? Please tick all that apply.
Friends/ neighbours_____ Family_____ TV/ radio_____ Hospital charts/ posters_____ Health care worker_____ Doctor_____
Newspapers/ magazines_____ Other (please state)_____
9. Do you think gestational diabetes is a serious condition? Yes_____ No_____ Don't know_____
10. Do you think exercising regularly helps to prevent gestational diabetes? Yes_____ No_____ Don't know_____
11. How many times each week do you exercise? 0_____ 1-2_____ 3-4_____ >5_____
12. What type of exercise do you do?
Running_____ Jogging_____ Cycling_____ Swimming_____ Sports (e.g. basketball/football)_____ Dance_____
Brisk walking_____ Weight training_____ Stretches_____ Gymnastics_____ Pilates/Yoga_____ Other (please state)_____
13. Do you think a healthy diet helps to prevent gestational diabetes? Yes_____ No_____ Don't know_____
14. How many portions of fruit or vegetables per day do you eat? 0_____ 1_____ 2_____ 3_____ 4_____ 5+_____
15. Do you eat a lot of processed foods or foods high in sugar? Yes_____ No_____ Don't know_____

Thank you very much for taking the time to complete this questionnaire.

Appendix 3

Questionnaire - Samoan Translation

Tausaga/Matua: _____
Masina o le ma'i taga_____
O oe se sitiseni/tagataanuu Samoa? Ioe_____ Leai_____
Fa'amolemole togi le pusa talafeagai mo fesili taitasi.
1. Sa maua muamua oe I le ma'I suka? Ioe_____ Leai_____ Le mautinoa_____
2. Na maua oe I le ma'I suka I le taimi o e ma'I taga? Ioe_____ Leai_____ Le mautinoa_____
3. Ua fai se fanau? Ioe_____ Leai_____
4. Na iai ni faafitauli I le taimi fanauga o le fanau?
Leai_____ Pepe la'ititi_____ Pepe telē (ova ma le 9 pauna)_____ Pre-eclampsia_____
Fanau ae lei 'o' ile taimi e tatau na fanau ai_____ Maliu ile taimi e fanau ai/malaia_____ Ni isi ituaiga faamalosi tino_____
5. E iai ni isi o le tou aiga o maua I le ma'I suka? Ioe_____ Leai_____
6. I sou oe manatu, e ono maua e se faafine ma'I taga le ma'I suka? Ioe_____ Leai _____ Le mautinoa_____
7. I sou oe manatu, o a ni auga poo ni mafuaaga e ono maua ai se fafine I le ma'I suka I le taimi o le ma'I taga? Mafua:
Ona o le tino puta (ae le'I ma'I taga)_____ Ona o le tino puta a'o ma'I taga_____
Ona o maua I le ma'I suka_____ Ona e maua se tagata o le aiga I le ma'I suka_____
8. O afia tagata poo ni faasalalauga na e iloa ai le tali o le fesili numera 7?
Uō poo tuaoi_____ Aiga_____ Televise poo leitiō faasalalau_____ Ata tusitusia o le soifua maloloina_____
Au faigaluega soifua malōlōina_____ Alii poo tamaita'I foma'i_____ Nusipepa poo tusi ata faasalalau_____
Ni isi auala faasalalau(upega tafailagi, facebook mmf)_____
9. I sou oe manatu, e tele se aafiaga poo se faafitauli o le ma'I suka a'o ma'I taga se fafine? Ioe_____ Leai_____ Le mautinoa_____
10. I sou oe manatu, e iai se fesoasoani o le faamalosi tino I le faaitiitia lea o le maua o se fafine ma'I taga I le ma'I suka?
Ioe_____ Leai_____ Le mautinoa_____
11. E faafia ona e faamalosi tino I aso o le vaiaso? 0_____ 1-2_____ 3-4_____ ova ma le 5 poo le_____
12. O le a le ituaiga faamalosi tino e te faatinoa?
Tamo'e_____ Vili uila_____ Aau_____ Taaloga(pei o le Pasiketi polo, soka, lakapi)_____
Siva(zumba, afia e x mmf)_____ Si'isi'I u'amea mamafa_____ Ni isi ituaiga faamalosi tino_____
13. I sou oe manatu, e afia e le ai meaai paleni mo le soifua maloloina ona tete'e atu I le ma'I suka a'o ma'I taga?
Ioe_____ Leai_____ Le mautinoa_____
14. E fia le aofa'I o fualaauaina ma meaai taumafamata e te tausamiina I le aso e tasi?
0_____ 1_____ 2_____ 3_____ 4 _____ 5 pe ova atu_____
15. E tele lau tausami I meaai tuuapa po meaai e tele ai le suka? Ioe_____ Leai_____ Le mautinoa_____

Faafetai tele mo le fa'aavanoaina o lou taimi e taliina ai lenei pepa fesili.

MEDICAL SCHOOL HOTLINE

Pipeline to Health Careers in Hawai'i

Jolene Muneno MEd, MS; Kauionalani Mead MEd; Priscilla Mapelli BA; Erica Davis MSNP; and Kelley Withy MD, PhD

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

Introduction

The mission of the Hawai'i/Pacific Basin Area Health Education Center (HPB AHEC) is to improve the health of the underserved through education. HPB AHEC assists individuals from economically and educationally disadvantaged backgrounds to successfully pursue careers in all health professions. This is accomplished by coordinating and leveraging existing resources to create a robust, integrated, and collaborative pathway for disadvantaged students. AHEC provides services for students at different levels of the educational pipeline that include high school students, undergraduate students, adult non-traditional learners and health care trainees.

HPB AHEC achieves this through statewide recruitment visits that provide inspirational Health Careers messages through the Hawai'i Pre-Health Career Corps program, Teen Health Camps, Hawai'i Speakers Bureau, Health Career Navigator Book, Career Awareness Posters, the Hawai'i Distributed Learning Network.

The Hawai'i Pre-Health Career Corps

The Hawai'i Pre-Health Career Corps (PHCC) is a pipeline program for high school and undergraduate students. The purpose of the PHCC is to increase the number of disadvantaged students entering health professions. Students have the opportunity to explore health careers, learn about health professions and learn how to improve academic success.

The PHCC Program began in January 2016 and collaborates with local organizations to facilitate access to all available resources in the state of Hawai'i. The PHCC offers activities that include mentoring and shadowing experiences, career development, research, and cultural competency training.

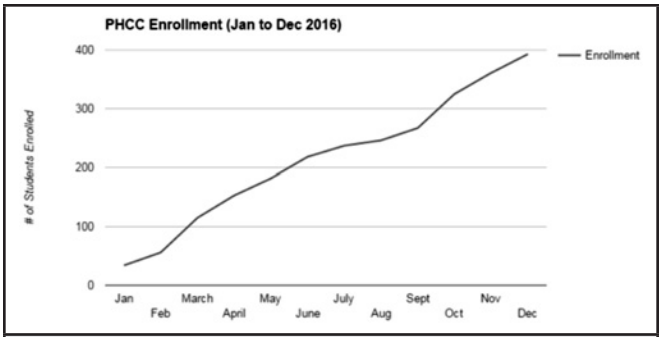
PHCC members are invited to participate in a variety of year-round coordinated experiences that include the following: (1) Health Workshops, (2) SAT/ACT/MCAT Test Prep, (3) College Tours, (4) Medical Facility Tours, and (5) Mentoring/Advising Sessions. Participants are also exposed and linked to volunteer, research and shadowing experiences that address health careers.

PHCC is a high school program with an additional four-year college undergraduate option program. In the first year of high school, corps members explore health care careers. In the second year of high school, corps members have the opportunity to shadow up to three healthcare professionals in their desired field. The third year of high school focuses on extensive health care exploration, test prep, and becoming a leader. In the fourth year of high school, students receive information on the college admission process, increase their shadowing and mentorship opportunities, as well as, have the opportunity to become a Pre-Health Career Corps Leader.

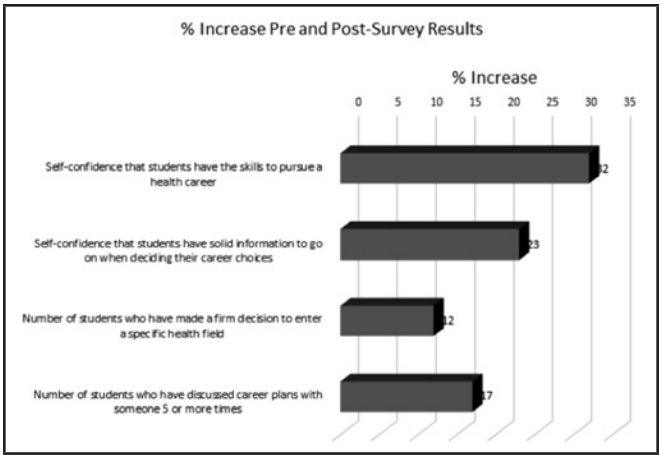
Corps members who have completed the High School PHCC Program are automatically accepted into the undergraduate PHCC Program. In this program, corps members have opportunities to progress through research experiences. This begins with student involvement in the health workforce assessment in Hawai'i (AHEC activity) that involves literature searches, data analysis and potentially publishing an academic paper. Subsequently, students are involved in laboratory based research activities such as biomedical research projects through the STEP UP Diabetes Research Program (http://www.pacificstepup.org/), the IDeA Network for Biomedical Research Excellence (http://inbre.jabsom.hawaii.edu/), and the Hawai'i Pacific Health research program (https://www.hawaiipacifichealth.org/careers/summer-student-research-program/).

In 2016, the first year of the program, 393 students enrolled in the PHCC. Over 60% of Corps members were both economically and educationally disadvantaged. Nineteen types of workshops were held, spanning 35 days, with 263 total Corps members attending. The workshops include SAT/ACT Prep, cardiopulmonary resuscitation (CPR) certification, blood pressure certification, Health Insurance Portability and Accountability Act (HIPAA) training, health professional panels and mixers, anatomy lab & simulation lab field trips, problem based learning demonstrations, shadowing and networking, interview skills, resume building, and a Student Leadership Day. Throughout the year 321 contacts were related to mentoring and advising, and successfully setting up 75 shadowing, 57 research, and 86 volunteer experiences. The year ended with a Corps Awards ceremony where students were honored for their leadership and dedication to health care.

In December, a follow-up survey was sent to Corps members who enrolled in early 2016. Results showed that 60% of Corps



PHCC Enrollment



Percentage Increase Pre and Post-Survey Results

Hawai□i Pre-Health Career Corps

members increased in their health career knowledge. Results demonstrated the following: a 32% increase self-reported confidence that they have the skills to pursue a health career; a 23% increase in their confidence that they have solid information to go on in deciding their career choices; a 12% increase in the number of students who have made a firm decision to enter a specific health field; and a 17% increase in the number of students who have discussed career plans with someone in the health field five or more times.

In the coming years, a goal is to expand the Hawai'i Pre-Health Career Corps to all neighbor islands. The expansion will include island specific health exploration workshops, mentoring, academic advising, shadowing, and research experiences. By expanding to neighbor islands, the mission is to increase the number of students interested in healthcare by providing them guidance and support to further their education.

Teen Health Camp

Teen Health Camp (THC) is a student-run motivational, career-oriented, mentorship program targeted for intermediate and high school students in rural Hawai'i. The program serves 250 students per year. THC is a one-day intensive camp that consists of six workshops: Casting, Suturing, Healthy Choices (Nutrition), Decisions We Make (Public Health), Health Care Careers and a community-decided topic. There are three to five Teen Health Camps throughout the academic year: two Big Island Camps; one John A. Burns School of Medicine (JABSOM) Camp; two neighbor island camps (rotated between Moloka'i, Maui and Kaua'i). THC provides career knowledge, funds hands on activities and participants meet potential career mentors including healthcare professionals, healthcare students, and pre-healthcare college students.

Hawai‘i Speakers Bureau

The Speakers Bureau arranges practicing health care providers to visit schools to discuss their careers and educate students about health opportunities. There are over 100 health care professionals in the Speakers Bureau who volunteer their time to speak at public and private schools across the State. In 2016, Speakers Bureau members made presentations to 1,372 students. Speakers talk about their journeys toward becoming health professionals, what a typical work day is like for them, how the current unit students are studying relates to their professions, and answer student questions. The goal is to be able to access one central phone number and website where anyone in the State will be able to request a speaker for their career fair, classroom, event, or a visit to a health professions school: 808-692-1060 and http://www.ahec.hawaii.edu/request-a-speaker/.

Hawai‘i Health Career Navigator Book

The Hawai‘i Health Career Navigator is a 140-page book that was created to provide comprehensive information describing the local resources that encourage the pursuit of health careers, including community-based, hospital-based, and academic programs. The Navigator provides readers an overview of health career job options, descriptions, salaries, and the availability of college degree programs in the islands. The book is also downloadable online at: http://www.ahec.hawaii.edu/resources/health-career-navigator/.

The Navigator has been delivered to every school counseling office in Hawai‘i, as well as to all Pre-Health Career Corps students. An interactive online quiz is also available for students to learn more about which health careers match their interests and preferences: http://www.ahec.hawaii.edu/which-health-careers-are-right-for-you-online-quiz/.

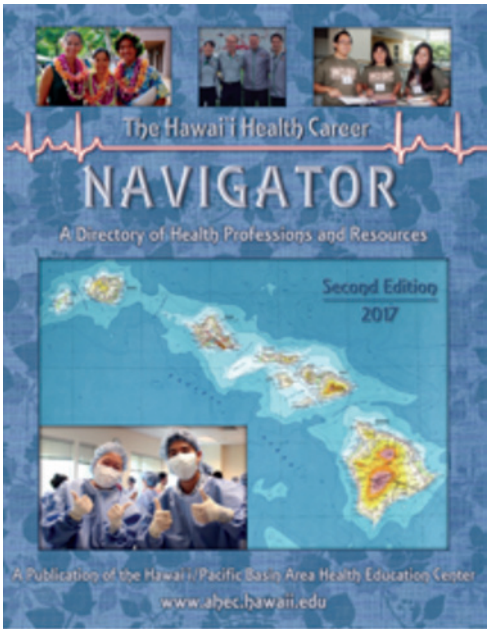
Career Awareness Posters

HPB AHEC's Career Awareness Posters feature local Native Hawaiian Scientists that includes their photo, education, reason for choosing their field, why they were interested in their field of study and career path. Two interviews have already been completed with Dr. Alika Maunakea, a Native Hawaiian who is a Biomedical Researcher, and Dr. Kahea Rivera, the first Native Hawaiian female cardiologist in Hawai‘i. The posters will be sent to schools, Workforce Investment Centers, Community Health Centers, community colleges, and community organizations to display in classrooms and hallways to inspire students with local role models who have successful science careers.

JABSOM Field Trips

HPB AHEC leads school tours of the John A. Burns School of Medicine. Students participate in hands-on tours of SimTiki (the simulation lab), the anatomy lab, the University of Hawai‘i Cancer Center, and the Native Hawaiian Healing Mala (garden). In 2016, HPB AHEC hosted field trips for over 400 students.

Teen Health Camp



Hawai‘i Health Career Navigator

Career Awareness Poster

Hawai‘i Distributed Learning Network (HDLN)

With the guidance of Danny Wyatt MA, an expert in college preparation education for underserved students across the Pacific Basin, HPB AHEC's next project is to adapt the College and Career Success text by Dr. Marsha Fralick for Native Hawaiian and Pacific Islander cultures. This interactive online text will have 14 modules (see Table 1).

HPB AHEC staff has received training from the author to teach the curriculum. Staff are currently developing video introductions, activities, and vignettes, and will pilot the program in 2017 with economically and environmentally disadvantaged Corps members.

Table 1. Hawai‘i Distributed Learning Network

Career Success:	College Success:	Lifelong Success:
Motivation & Control	Time & Money	Critical & Creative Thinking
Personality	Memory & Reading	Planning Career/Education
Learning Style	Notes, Writing	Computer skills
Interests/Values	Test Taking	Reading skills
Email/social media	Math and Science	Professionalism

Conclusion

AHEC works to attract thousands of students to health careers each year and support them through the preparation, application and training process. Interested individuals can find more information on AHEC's website: www.ahec.hawaii.edu.

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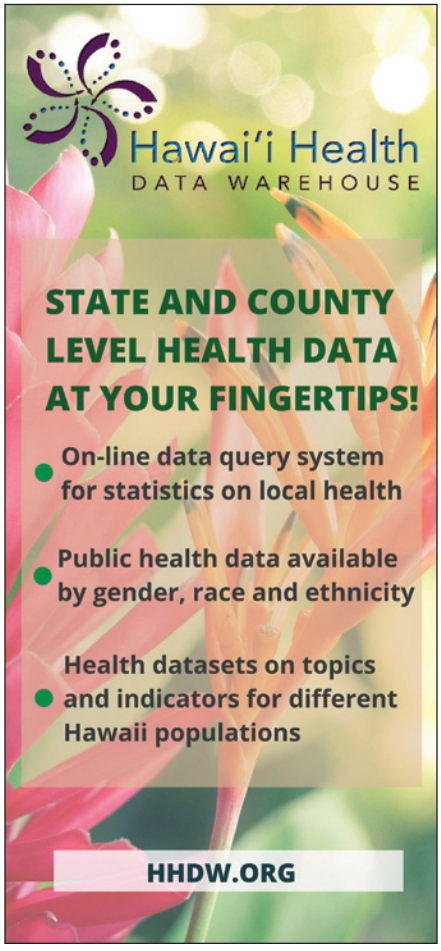


Updates on *Clostridium difficile* Infection: Advances in Laboratory Testing to Aid Diagnosis and Treatment

Louis Lteif PharmD, BCPS

HJMPH contributing editor of the Daniel K. Inouye College of Pharmacy Scripts column, Carolyn Ma PharmD, BCOP, is a founding faculty member for the Daniel K. Inouye College of Pharmacy and is currently Associate Professor and Dean for the University of Hawai'i at Hilo Department of Pharmacy Practice. Dr. Ma is a Board Certified Oncology Pharmacy Specialist with experiences in health systems administration and pharmacy academe.

Abstract

Clostridium difficile *remains a major source of nosocomial infections and associated diarrhea. More recently, community-acquired cases are on the rise creating a concern for a serious public health threat. Appropriate infection control precautions as well as prevention and optimal management may help to avoid detrimental outbreaks. A key step is utilizing laboratory testing for quick and accurate diagnosis of potential cases. This overview article describes* Clostridium difficile *infection control and prevention methods and updates the most recent management strategies including a focus on the utilization and interpretation of laboratory diagnostic testing and appropriate treatment.*

Keywords

Clostridium difficile *infection, laboratory testing,* Clostridium difficile *associated diarrhea, update, management, diagnosis*

Introduction

Clostridium difficile infection is regarded as one of the leading causes of nosocomial infections and diarrhea.[1,2] The spore forming, toxin-producing anaerobic bacteria is associated with significant morbidity and mortality as well as being a substantial pharmacoeconomic burden on institutions and society.[3] The ability of *C. difficile* to form spores contributes to its long survival capacity and ultimately difficulty in eradication. *C. difficile* spores can be shed in the gastrointestinal tract by either symptomatic or asymptomatic patients.[4] Spores can also survive up to 5 months on inanimate surfaces including hospital materials, tools and equipment.[4] This fact has led to a rise of *C. difficile* cases derived from exogenous sources with transmission occurring through the fecal-oral route. [4] Therefore, it is imperative to implement appropriate prevention and infection control strategies to decrease and hopefully completely prevent *C. difficile* infections (CDI) and transmission, especially within institutions such as hospitals, long term care facilities, nursing homes and outpatient clinics. The endogenous source of infection through the traditional risk factors (mainly exposure to antimicrobials within the previous 8 weeks) remains an important source of CDI. Recently there has been an alarming rise of community-acquired cases with some studies demonstrating that up to 41% of all CDI cases were attributable to a community origin.[5] In Hawai'i, the most recent figures from the Department of Health report 258 hospital-onset CDI cases in 2014, however many more cases were admitted and treated for CDI indicating a higher proportion of community origin CDI.[6] In the midst of this increasing public health threat, it is crucial to appropriately identify and diagnose cases including in the out-patient setting, provide appropriate treatment and prevent transmission. This article described a brief overview on the pathogenesis and manifestation of CDI, prevention and infection control methods, the latest on the available laboratory testing and appropriate interpretation to aid in the diagnosis of CDI as well as treatment overview updates.

Pathogenesis and Presentation

The pathogenesis of CDI is a function of *Clostridium difficile* colonization in the gastrointestinal tract, the ability of this anaerobic organism to produce toxins, and the host's immune response. Colonization by *C. difficile* requires a disruption of the normal colonic flora that facilitates the overgrowth and colonization of the bacteria by decreased competition for nutrients

List and definition of abbreviations	
CDI	Clostridium difficile infection
SHEA	Society of Healthcare Epidemiology of America
IDSA	Infectious Diseases Society of America
ASP	Antimicrobial Stewardship Program
HASC	Hawai'i Antimicrobial Stewardship Collaborative
CT	Computed Tomography
GDH	Glutamate dehydrogenase
EIA	Enzyme Immunoassay
PCR	Polymerase Chain Reaction
NAAT	Nucleic Acid Amplification Test
WBC	White Blood Cells
FDA	US Food and Drug Administration
OR	Odds Ratio
CI	Confidence Interval
IV	Intravenous

and attachment sites in the gut wall.[7] Exposure to antibiotics is the greatest risk factor for colonic disruption. Theoretically, all antibiotics may cause CDI but the antibiotics that pose the highest risk include cephalosporins, clindamycin, and fluoroquinolones. Receipt of antibiotics was recently associated with increased risk of CDI development in subsequent hospitalized patients occupying the same bed as the previous patients who received the antibiotics. The recent retrospective cohort demonstrated a 22% increased risk of CDI in subsequent patients thereby showing the potential impact of antibiotics in relation to CDI even in patients who do not receive them.[8] Other risk factors for colonic disruption and colonization include chemotherapy exposure, elderly age, prolonged hospitalization or exposure to healthcare settings, immunodeficiency, and use of proton pump inhibitors.[1] Next, CDI only develops if the colonizer strains are toxin producing. Toxins A and B are produced by most toxigenic strains and contribute to the pathogenesis of CDI. Both toxins induce cytotoxic effects on colonic epithelial cells leading to cell damage and death ultimately resulting in patients' experiencing uncontrollable diarrhea. It has been suggested that toxin A disrupts the colonic mucosal cell adherence thus allowing toxin B entry to produce its cytotoxic effects.[9] The extent of clinical manifestations will depend on the host immune response and the development of anti-toxin IgG antibodies.[10]

Presentation could range from asymptomatic carriage to fulminant disease with symptoms typically developing two to three days after colonization. The hallmark presentation includes watery diarrhea (usually three or more episodes per day), abdominal cramping, fever and leukocytosis; however these symptoms may not always be present in all patients. Signs and symptoms indicating severe and complicated disease include hypotension, dehydration, ileus, hypoalbuminemia, renal failure and electrolyte imbalance with the most serious infections potentially advancing to toxic megacolon, shock and death.[1]

Prevention and Infection Control

The latest guidelines published in 2010 by the Society of Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) recommend the implementation of an Antimicrobial Stewardship Program (ASP) in hospital institutions as a mean to restrict inappropriate utilization of antibiotics and thus reduce and prevent CDI occurrence.[11] Decreasing the number, frequency and duration of unnecessary antibiotics reduces the chance of colonic flora disruption and thus occurrence. Several studies have shown the impact that a well implemented ASP can have on reducing CDI. [12-15] In this state, the Hawai'i Department of Health, the Daniel K. Inouye College of Pharmacy, and several institutions have established the Hawai'i Antimicrobial Stewardship Collaborative (HASC). The main goals of HASC are to assist institutions in developing and maintaining ASPs which in turn would optimize use of antimicrobials and reduce onset of CDI. Participating institutions are able to report CDI data through the National Healthcare Safety Networking reporting system as well as sharing efforts conducted to implement strategies to reduce hospital-acquired CDI.[16] Another intervention to reduce CDI is the use of administering probiotics with an antibiotic course for the primary prevention of CDI.[11] At the time of the SHEA/IDSA guidelines development there was insufficient data as to the benefit of probiotics. The topic remains controversial as various studies have led to different conclusions with some showing benefits while others failing to do so. A recent meta-analysis demonstrated greater than a 50% reduction in CDI occurrence in patients who received probiotics within two days of antibiotic administration versus patients who received placebo.[17]

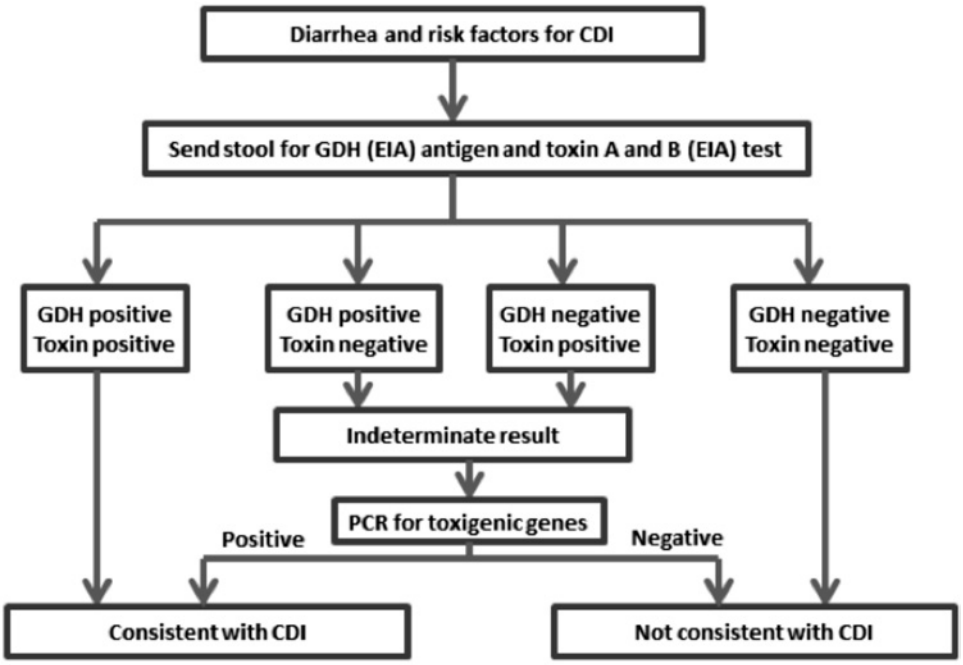
Effective institutional Infection Prevention and Control programs may play a significant role in avoiding outbreaks of CDI and stop transmission within hospitalized patients. SHEA/IDSA guidelines recommend several interventions that include isolating symptomatic patients in private rooms with contact precautions until diarrhea resolves, requiring health-care providers and visitors to wear gown and gloves and washing hands with soap and water upon exiting rooms, cleaning rooms with chlorine-containing products and replacing disposable equipment.[11] Asymptomatic carriers identified through diagnostic investigation do not require isolation with contact precautions.

Current Testing and Diagnosis Approaches

CDI diagnosis is mainly through clinical symptoms and laboratory stool testing. Adjunctive diagnostic tools such as computed tomography (CT) of the abdomen and pelvis or endoscopy may be warranted for certain cases. For patients with severe/fulminant colitis, CT of the abdomen and pelvis with contrast will help to qualify them for surgery. CT findings associated with *C. difficile* colitis include colonic wall thickening and mucosal edema while findings such as air fluids, seven or more centimeters of dilatation and "thumb printing" are consistent with toxic megacolon.[18] Endoscopy is not warranted in patients with a classical picture of CDI and is usually reserved for differential diagnosis requiring visualization or biopsy, however it might be helpful by visualizing pseudomembranes in a subset of patients with ileus or fulminant colitis in the absence of diarrhea.[18]

In general, diagnosis with laboratory testing should be prompted when patients experience three or more loose stools in a twenty-four hour period or if ileus is suspected in addition to the presence of CDI risk factor(s) previously mentioned (antibiotic use, elderly, prolonged hospitalization).[11] It is important to note that laboratory testing does not differentiate between CDI and asymptomatic carriage, therefore it is crucial that liquid stool, not formed stool be sent for testing. Additionally there is no role for repeat testing or test for cure in patients receiving treatment, as stool assays may remain positive during or after recovery.[11] For patients presenting with ileus, a perirectal swab for toxin assay or culture might be performed.

The general approach for laboratory testing of CDI is represented in Figure 1.[11] In patients with diarrhea and identified risk factors, one liquid stool sample is sent for glutamate dehydrogenase (GDH) and toxin A and B testing and if needed a follow-up Polymerase Chain Reaction (PCR) test is conducted.



GDH: Glutamate dehydrogenase; EIA: Enzyme Immunoassay; PCR: Polymerase Chain Reaction

Figure 1. Clostridium difficile Infection Diagnostic Algorithm[11]

A positive result for both GDH and toxin testing indicates a CDI diagnosis, whereas if both test results are negative then the diagnosis is not consistent with CDI. An indeterminate result occurs with discordant results, for instance, when a positive GDH occurs with a negative toxin test or a negative GDH with a positive toxin test. For these types of indeterminate cases, a PCR test for toxigenic genes is then performed. A positive PCR result then indicates probable CDI, and a negative result would indicate probable lack of infection. The two-step algorithm approach described has a specificity of 0.92-1 for detecting CDI and a sensitivity of 0.68-1. A single step PCR could also be adopted with lower specificity and sensitivity of 0.94-0.97 and 0.86-0.92 respectively.[19] Indeterminate results can be due to several reasons. First, one of the two tests could be false negative. Secondly, the GDH could be positive and the toxin test would be a true negative in which case the patient has nontoxigenic *C. difficile* colonization. Thirdly, one of the two tests (typically the toxin test) could be falsely negative as a result of low density of the organism in the stool in which case the patient would be an asymptomatic carrier of toxigenic *C. difficile* however without active disease.[20-22]

The GDH antigen is an enzyme produced by all *C. difficile* isolates. Testing for GDH antigen is done through the utilization of antibodies enzyme immunoassay that detect the GDH enzyme, however the test cannot differentiate between toxigenic and non-toxigenic strains hence its lower specificity (around 92%).[23] To avoid excessive false positive results it is therefore only useful in a multi-step approach as described in Figure 1. Advantages of GDH antigen testing include its high sensitivity (closer to 100%), quick turn-around time and relative low-cost.[24] Toxin testing is another antibody test that detects the presence of toxins A and/or B. Traditionally it was thought that toxin B was the more clinically relevant toxin however testing for both toxins is recommended and is usually available with current testing panels. Testing for both toxins increases the sensitivity for accurate diagnosis up to approximately 75% and the specificity up to 99%, however there is still a relatively high rate of false negative results because 100-1000 picograms of either toxins must be present to be detected by the test.[25,26] Similar to the GDH antigen testing, the toxins test has a fast turn-around time (minutes to an hour) and with relatively low-cost. Nucleic Acid Amplification Testing (NAAT) methods, most commonly through PCR are utilized to detect one or more genes specific to toxigenic strains. The two genes that encode for toxin B and A, tcdB and tcdA, respectively, occur mainly during the stationary phase of growth of *C. difficile*. A third gene, tcdC, is a negative regulator of toxin production during the exponential phase of growth of *C. difficile*.[27] While the sensitivity and specificity of the PCR testing is higher than the antibody testing, it does not test for active toxin production and can also detect asymptomatic carriage, thereby the importance of only testing liquid stools from patients with three or more loose stools per day.[28-32] Unlike antibody tests, PCR turn-around time is longer (up to hours) and may not be available at all institutions.

Additional testing methods that have fallen out of favor due to turn around time and labor intensity include the cell culture cytotoxicity assay and the *C. difficile* anaerobic cultures. The cell culture cytotoxicity assay consists of adding a prepared

stool sample that has been diluted, buffered and filtered to a monolayer of cultured cells. If *C. difficile* toxin is present then a cytopathic effect consisting of rounding of fibroblasts will occur. Specificity is demonstrated by adding an antiserum that will neutralize the cytopathic effect. Despite being labor intensive and having a slow turn-around time, this cytotoxicity assay has a higher sensitivity than immunoassays described above and could be useful in cases where PCR reflects asymptomatic carriage.[33] *C. difficile* grows on a selective medium anaerobic culture. The disadvantage to this test is that the anaerobic culture cannot distinguish toxin producing from non-toxigenic strains so this test must be followed by strain testing for toxins with either the toxin test or PCR. Anaerobic culture followed by strain testing for toxin is considered the gold standard but due to very slow turn-around time and labor intensity the combination is not routinely performed. In instances of outbreaks it could prove useful for epidemiological purposes since it is the most sensitive test for CDI.[33]

Table 1. *Clostridium dificile* Treatment Recommendations SHEA/IDSA Guidelines 2010[11]

Mild-Moderate WBC <15 AND SrCr <1.5 times baseline	Metronidazole 500 mg PO TID for 10-14 days
Severe WBC >15 OR SrCr>1.5 times baseline	Vancomycin 125 mg PO QID for 10-14 days
Severe complicated (hypotension/shock, ileus, megacolon)	Vancomycin 500 mg PO QID PLUS Metronidazole 500 mg IV TID
First recurrence	Same as initial episode
Second recurrence	Oral vancomycin taper and/or pulse therapy*

*125mg 4 times a day for 10-14 days followed by 125 mg 2 times a day for 7 days followed by 125 mg once a day for 7 days followed by 125 mg every 2-3 days for 2-8 weeks

WBC: White Blood Cells; SrCr: Serum Creatinine;mg: milligrams;PO: By mouth;TID: Three times a day;QID: Four times a day;IV: Intravenous

Update on Treatment

The 2010 SHEA/IDSA guidelines recommend discontinuing the offending antibiotic as soon as possible if CDI is suspected or diagnosed. If antibiotics are needed for a concomitant infection then the narrowest spectrum effective antibiotic(s) should be utilized.[11] Antiperistaltic agents such as loperamide, diphenoxylate/atropine or opiates should be avoided since they could mask symptoms and precipitate toxic megacolon by trapping the CDI toxins and exacerbating toxin-mediated disease. The treatment recommendations based on disease severity classification are summarized in Table 1.[11] Oral metronidazole is the drug of choice for initial mild-moderate cases in which patients present with a white blood cell (WBC) count of 15,000 cells/microliter or lower and a serum creatinine level less than 1.5 times the baseline or pre-CDI level. For initial severe cases defined as either a WBC count of 15,000 cells/microliter or higher or a serum creatinine level more than 1.5 times the baseline or pre-CDI level, oral vancomycin is the recommended therapy. Initial severe episodes complicated with hypotension or shock, ileus or megacolon warrant dual therapy with oral vancomycin plus intravenous metronidazole. In severe complicated cases vancomycin could be delivered through a nasogastric tube or via a rectal enema if complete ileus is present. Colectomy might be required for select complicated patients including toxic megacolon, colonic perforation or acute abdomen.[11]

Patients experiencing their first recurrent episode, usually within eight weeks of the initial episode should be treated in the same fashion as the initial episode. A second recurrence requires an oral vancomycin tapered schedule and/or a pulse regimen as described in Table 1. Utilization of metronidazole for long-term therapy or beyond a first recurrence is not recommended due to the potential for cumulative neurotoxicity.[11]

Several treatment modalities have been used or approved after the publication of the SHEA/IDSA guidelines in 2010 and mainly include fidaxomicin, fecal microbiota transplant and bezlotoxumab. In 2011, fidaxomicin received a US Food and Drug Administration (FDA) approval for the treatment of CDI and is listed as a treatment option in the 2013 European guidelines for recurrent episodes.[34]Fidaxomicin given as 200 mg orally every 12 hours was compared to vancomycin 125 mg orally every 6 hours in two randomized trials and had similar clinical cure rates but lower recurrence rates (14% versus 26% and 15.4% versus 25.3% in each trial, respectively).[35,36] A meta-analysis compared fidaxomicin to metronidazole in indirect comparisons and while clinical cure rates were similar, fidaxomicin was associated with reduced recurrence in severe cases (OR = 0.19 with 95% CI= 0.04-0.95) as well as sustained cure rates.[37] Due to its higher cost and relatively limited clinical experience, fidaxomicin is currently typically reserved for recurrent cases versus initial episodes.

Fecal microbiota transplantation is a technique that transfers fecal content from a healthy donor into the gastrointestinal tract of another patient. The goal is to replenish the disrupted microbiome. Fecal microbiota transplantation is associated with decreased recurrence rates and is more effective at treating resistant cases compared to standard therapy. Though several routes have been studied (oral capsules, nasoduodenal tubes, endoscopy and enema) there is no optimal dose, route and target patient population yet established and the modality is reserved for recurrent cases or for patient who have failed other treatment options.[38-41] Generally, institutions that offer this technique have established protocols since this procedure requires extensive steps including obtaining an Investigational New Drug authorization from the FDA. This treatment option is not currently available in Hawai'i.[42]

Bezlotoxumab is the newest therapeutic agent and is a monoclonal antibody that binds to toxin B, thus neutralizing its effect. The FDA approved bezlotoxumab for use in patients who have already received standard therapy and are at a high risk for recurrence. It is given concurrently with standard therapy to prevent recurrence. The manufacturer's definition

of patients at high risk for recurrence includes patients 65 years and older, immunocompromised state, history of CDI in the past 6 months, severe CDI at presentation or if the patient has *C. difficile* ribotype 027, a hypervirulent strain that caused the largest CDI outbreak to date.[43,44] Bezlotoxumab was assessed in two randomized clinical trials and was given as a single 10mg/kg IV infusion dose in addition to standard of care that included metronidazole, vancomycin or fidaxomicin. Patients in the bezlotoxumab group experienced less recurrence at 12 weeks follow-up as compared to the placebo plus standard of care group. The most common reported drug side effects included exacerbation of heart failure and infusion related reactions.[43] Other antibiotics with less established role in CDI treatment include rifaximin, FDA approved for traveler's diarrhea in addition to an orphan drug status for hepatic encephalopathy and tigecycline, an intravenous antibiotic with broad spectrum coverage ideally reserved for resistant organisms as last line therapy. Table 2 summarizes the newer therapies in addition to the place of therapy of the alternative agents utilized for CDI.

Table 2. Newer and Alternative Therapies for *Clostridium dificile*

Fidaxomicin	FDA approved and recommended by the European guidelines Reserved for recurrent cases as it demonstrated decreased recurrence compared to standard therapy
Fecal Microbiota Transplant	No optimal dose, route or candidates determined Reserved for recurrent cases and resistant cases failing standard therapy
Bezlotoxumab	Not an antibiotic, given in conjunction with standard of therapy for high risk patients Decreased recurrence rates compared to placebo up to 12 weeks of follow-up
Rifaximin	Evidence of decreased recurrence up to 3 months of follow-up when given for 20 days after standard of therapy
Tigecycline	Case reports of successful treatment of severe refractory CDI with tigecycline

Conclusion

As antibiotic misuse and abuse remains a problem, CDI continues to constitute a significant public health threat with community acquired cases on the rise. With the advancements in laboratory testing and classifications, clinicians can properly diagnosis CDI and provide timely and appropriate treatment(s) thus reducing the possibilities of recurrence and avoid outbreaks. Future steps in CDI management include the expansion of effective therapies as well as the potential primary prevention through the development of an immunogenic vaccine.

Conflict of Interest

The author has no conflict of interest to report.

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General Recommendations on Data Presentation and Statistical Reporting (Biostatistical Guideline for HJM&PH)
[Adapted from Annals of Internal Medicine & American Journal of Public Health]

The following guidelines are developed based on many common errors we see in manuscripts submitted to HJMPH. They are not meant to be all encompassing, or be restrictive to authors who feel that their data must be presented differently for legitimate reasons. We hope they are helpful to you; in turn, following these guidelines will reduce or eliminate the common errors we address with authors later in the publication process.

Percentages: Report percentages to one decimal place (eg, 26.7%) when sample size is >=200. For smaller samples (<200), do not use decimal places (eg, 26%, not 26.7%), to avoid the appearance of a level of precision that is not present.

Standard deviations (SD)/standard errors (SE): Please specify the measures used: using "mean (SD)" for data summary and description; to show sampling variability, consider reporting confidence intervals, rather than standard errors, when possible to avoid confusion.

Population parameters versus sample statistics: Using Greek letters to represent population parameters and Roman letters to represent estimates of those parameters in tables and text. For example, when reporting regression analysis results, Greek symbol (β), or Beta (b) should only be used in the text when describing the equations or parameters being estimated, never in reference to the results based on sample data. Instead, one can use "b" or β for unstandardized regression parameter estimates, and "B" or β for standardized regression parameter estimates.

***P* values:** Using *P* values to present statistical significance, the actual observed *P* value should be presented. For *P* values between .001 and .20, please report the value to the nearest thousandth (eg, $P = .123$). For *P* values greater than .20, please report the value to the nearest hundredth (eg, $P = .34$). If the observed *P* value is greater than *.999*, it should be expressed as "$P > .99$". For a *P* value less than .001, report as "$P < .001$". Under no circumstance should the symbol "NS" or "ns" (for not significant) be used in place of actual *P* values.

"Trend": Use the word trend when describing a test for trend or dose-response. Avoid using it to refer to *P* values near but not below .05. In such instances, simply report a difference and the confidence interval of the difference (if appropriate), with or without the *P* value.

One-sided tests: There are very rare circumstances where a "one-sided" significance test is appropriate, eg, non-inferiority trials. Therefore, "two-sided" significance tests are the rule, not the exception. Do not report one-sided significance test unless it can be justified and presented in the experimental design section.

Statistical software: Specify in the statistical analysis section the statistical software used for analysis (version, manufacturer, and manufacturer's location), eg, SAS software, version 9.2 (SAS Institute Inc., Cary, NC).

Comparisons of interventions: Focus on between-group differences, with 95% confidence intervals of the differences, and not on within-group differences.

***Post-hoc* pairwise comparisons**: It is important to first test the overall hypothesis. One should conduct *post-hoc* analysis if and only if the overall hypothesis is rejected.

Clinically meaningful estimates: Report results using meaningful metrics rather than reporting raw results. For example, instead of the log odds ratio from a logistic regression, authors should transform coefficients into the appropriate measure of effect size, eg, odds ratio. Avoid using an estimate, such as an odds ratio or relative risk, for a one unit change in the factor of interest when a 1-unit change lacks clinical meaning (age, mm Hg of blood pressure, or any other continuous or interval measurement with small units). Instead, reporting effort for a clinically meaningful change (eg, for every 10 years of increase of age, for an increase of one standard deviation (or interquartile range) of blood pressure), along with 95% confidence intervals.

Risk ratios: Describe the risk ratio accurately. For instance, an odds ratio of 3.94 indicates that the outcome is almost 4 times as likely to occur, compared with the reference group, and indicates a nearly 3-fold increase in risk, not a nearly 4-fold increase in risk.

Longitudinal data: Consider appropriate longitudinal data analyses if the outcome variables were measured at multiple time points, such as mixed-effects models or generalized estimating equation approaches, which can address the within-subject variability.

Sample size, response rate, attrition rate: Please clearly indicate in the methods section: the total number of participants, the time period of the study, response rate (if any), and attrition rate (if any).

Tables (general): Avoid the presentation of raw parameter estimates, if such parameters have no clear interpretation. For instance, the results from Cox proportional hazard models should be presented as the exponentiated parameter estimates, (ie, the hazard ratios) and their corresponding 95% confidence intervals, rather than the raw estimates. The inclusion of *P*-values in tables is unnecessary in the presence of 95% confidence intervals.

Descriptive tables: In tables that simply describe characteristics of 2 or more groups (eg, Table 1 of a clinical trial), report averages with standard deviations, not standard errors, when data are normally distributed. Report median (minimum, maximum) or median (25th, 75th percentile [interquartile range, or IQR]) when data are not normally distributed.

Figures (general): Avoid using pie charts; avoid using simple bar plots or histograms without measures of variability; provide raw data (numerators and denominators) in the margins of meta-analysis forest plots; provide numbers of subjects at risk at different times in survival plots.

Missing values: Always report the frequency of missing variables and how missing data was handled in the analysis. Consider adding a column to tables or a footnote that makes clear the amount of missing data.

Removal of data points: Unless fully justifiable, all subjects included in the study should be analyzed. Any exclusion of values or subjects should be reported and justified. When influential observations exist, it is suggested that the data is analyzed both with and without such influential observations, and the difference in results discussed.

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THE WEATHERVANE

RUSSELL T. STODD MD; CONTRIBUTING EDITOR

GENE RESEARCH: DON'T ASK, DON'T TELL.
Developmental biologist Fredrick Lanner of the Karolinska Institute in Stockholm is the first researcher to publicly acknowledge editing genes in viable human embryos. It is almost certain that other researchers are doing similar experiments out of the public eye. Lanner believes that scientists should speak more freely about their work. "I'm doing my best to discuss these important experiments openly in scientific and general forums." When the powerful gene editor, CRISPR/Cas9 came on the research scene, scientists recognized the door was open for an exciting new field of genetic engineering. Human embryos left over from in vitro fertilization (IVF) would provide ready-made tissue for research. Now there are labs around the world plowing the field of genetic engineering. Lanner wants other scientists to discuss these important experiments openly in scientific and general public forms. Chad Cowan, stem cell biologist at Harvard University points out that researchers are often reluctant to talk with reporters until their work has been published. Moreover in the USA there is an abiding awareness of ownership and patents, kind of "mine, mine, mine."

WHEN SECOBARBITAL IS THE DRUG OF CHOICE.
Colorado is the latest state to sign on to assisted-suicide. Proposition 106 was passed in November 2016 which will allow adults who have six months or less to live, and are mentally competent, to take medication prescribed by a doctor to end their lives. Five states have a law that allows the practice; Oregon (it's law is the model for Colorado), Vermont, Washington, and California. In Montana the state Supreme Court ruled that doctors who provide "aid in dying" are allowed to use a terminally ill patient's consent as a defense if they are charged with homicide. In Oregon with the first such legislation in 1997, the number of annual fatal prescriptions has gradually risen reaching 218 in 2015. Supporters of the issue state the matter is a highly personal one that should be left to individuals, their families and doctors. On the opposite side, Colorado attorney Carrie Ann Lucas, who is on the board of *NOT DEAD YET*, a national disability-rights group opposes the law, "It simply lacks adequate safeguards to protect the most vulnerable people."

IF THIS WAS A BAR THEY WOULD LOSE THEIR LICENSES.
A patient in cardiac arrest was mistakenly not resuscitated because clinicians confused him with a patient who had DNR on file. Another patient was given an OK for surgery based on the wrong patient's records. He was found dead in his hospital room the following day. Such patient ID mix-ups are common and can have deadly consequences, according to a report from the Economic Cycle Research Institute (ECRI). The report analyzed 7,613 cases of so-called wrong patient errors at 181 health care organizations from January 2013 to July 2015. A federal law allows providers to share safety data without fear of liability, and probably represents only a fraction of the errors. Of the mistakes studied, 91% were caught before patients were harmed. Two were fatal and others might have been. One patient was given another's hypertension medication at 10 times the usual dose. Another patient was NPO, but was given a meal tray and nearly choked. Registration errors accounted for 13%, more than 33% of mix-ups involved diagnostic tests such as X-rays and lab work, 22% involved treatment and procedures. In some cases a patient's wristband was wrong, missing not legible, or simply not checked. The public is not aware of these problems. Just about every clinician involved in health care is at risk of making a wrong patient ID. Safety initiatives have led to many improvements in recent years, but the opportunity for ID mix-ups is increasing with many more lab tests, more imaging tests, and more procedures throughout the system. Whatever you are doing, stay sharp, check, and recheck.

ZIKA FINALLY GES SOME ACTION FROM CONGRESS.
After months of lobbying and pleading, Congress at last approved $1.1 billion for research on Zika. The measure might have passed last summer, but before it came to vote, a GOP sponsored amendment to exclude planned parenthood in Puerto Rico was tacked on, and that killed it. Zika infection causes almost no symptoms, but the virus can do serious damage to a developing fetus with devastating neurological injury during pregnancy. The mosquitos, Aedes albopictus and Aedes Aegypti, are mostly confined to the southern US, but extend north on the east coast as far as Connecticut. It can transmit Zika, dengue, malaria, chikungunya, and yellow fever. Scientists theorize that the mosquito could be wiped out with gene therapy, ala CRISPR/cas9. To date gene therapy cannot be considered, and Aedes is still swarming. Spread on repellant in our tropical climate.

MORE THAN THE OLFACTORY SENSE WAS OFFENDED.
For the first time in recorded history a fire broke out in an operating room when a 30 year-old woman passed gas during a laser procedure. She suffered burns to her thighs. The incident was reported in the press after the hospital completed its investigation.

WHEN TAKING AWAY HER KEYS JUST WON'T SUFFICE.
In Cheyenne, Wyoming, Ashley Basich, age 49, was arrested and charged with DUI when she was found late at night using an industrial fork-lift trying to move a van she claimed was blocking her driveway. She had commandeered the machine from the forest service department where she works. She had a cooler of beer aboard and was trying to operate the equipment wearing flip-flops. The obstructing van was found to be hers.

ADDENDA
- Sir Francis Galton was a brilliant Victorian age statistician who in vented psycho-metrics (IQ test) among other talents. He was a cousin of Charles Darwin.
- Texas executed three guys in one week. They didn't get a last meal. It was a buffet.

ALOHA AND KEEP THE FAITH **rts**
(Editorial comment is strictly that of the writer.)

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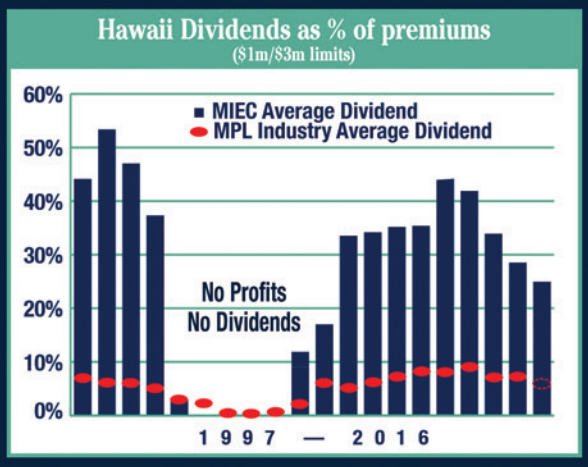

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